The Electrical World.

VOL. XXXIII. NEW YORK, MARCH 4, 1899. No. 9.

THE ELECTRICAL WORLD,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the United States, Canada or Mexico; other foreign countries, $6.00.

ANNOUNCEMENT.

From and after March 11 THE ELECTRICAL WORLD and "The Electrical Engineer" will be issued weekly as one publication, to be known as "Electrical World and Electrical Engineer," under the editorship of Mr. T. Commerford Martin and Mr. W. D. Weaver, and the business management of Mr. James M. Wakeman, until recently of the "American Machinist," and Mr. A. C. Shaw.

The combined journal will be conducted along broad and well determined lines as a high-class representative of the American electrical industry and of the electrical engineering profession. The best features of the original journals will be retained, and others introduced with the definite object of producing an electrical periodical without rival in its special field.

By thus combining, to the obvious advantage of the reader and the advertiser, the effort heretofore divided between the two leading weekly electrical publications, a technical and industrial journal will be produced that should worthily represent the important field covered, and rank among the great engineering and industrial periodicals of the world.

VOL. XXXIII. NEW YORK, MARCH 4, 1899. No. 9.

CONTENTS.

	PAGE.
Editorial	253
The Lewiston, Brunswick and Bath Street Railway	255
The Meran-Bozen Transmission	259
The Motor Vehicle in Commercial Operation, by G. Herbert Condict	261
Professor Rowland's Multiplex Printing Telegraph	262
Electrolytic Processes for the Extraction, Separation and Refining of Metal—II, by Dr. D. Tommasi	263
The Advantages and Disadvantages of the Electrical Profession	264
Motor Regulation and Efficiency, by Alton D. Adams	266
Alternating Currents Twenty-five Years Ago and To-day, by Edwin J. Houston and A. E. Kennelly	267
The Rise of the Stock Reporting Telegraph, by Ralph W. Pope	268
Some Reminiscences of the House Printing Telegraph, by J. E. Selden	270
Twenty-five Years, by Thomas Henning	271
Some Recollections of Twenty-five Years of Wire Making, by Eugene F. Phillips	272
Digest of Current Electrical Literature, compiled by Carl Hering	274
Automatic Steam Pump Regulator and Low-Water Alarm	280
A System of Electric Lighting for Railway Cars	280
An Electrical Cooking School	282
A Metallic Circuit Telephone Switchboard of New Design	282
China and Glass Insulators	282
A Removable Fuse Holder	284
"Sixteen to One"	284
An Electric Fan of New Design	284
A New Circuit Breaker	284
Departments:	
Financial Intelligence	285
Special Correspondence	285
General News	288
Personal Notes	289
Obituary Note—John Kruesi	290
Trade and Industrial Notes	290
Business Notice	291
Illustrated Record of Electrical Patents	291

A WORD OF FAREWELL.

After having devoted my energies for twenty-five years to the building up of THE ELECTRICAL WORLD, I have decided to retire from the field of technical journalism on this day, which marks the beginning of the second quarter-century of the life of this paper. Under the management to which it passes I am satisfied that standards will be established even higher than those which I have been able to attain, although the readers of THE ELECTRICAL WORLD do not need to be told, I think, how faithfully I have striven to give them a journal worthily representing the activity and progressiveness of the electrical industry. It also goes without saying that I feel sincere regret in severing the many pleasant business relations which have been formed in this field, and that I shall continue to follow with no little pride the future development of the paper which for so many years I have watched over, and which I now resign into hands competent to carry it to still greater achievements.

W. J. JOHNSTON.

TWENTY-FIVE YEARS IN ELECTRICAL JOURNALISM.

The quarter-century commemorated by this issue of THE ELECTRICAL WORLD is a period which, like the Golden Age of Athens, will always shine forth as one of the distinctive epochs in the history of the human race. Though the steam engine may have been a greater factor in influencing the social history of man, it has, owing to its more gradual growth and its homely utilitarianism, appealed but slightly to that great majority whose imagination has been so profoundly impressed by the rapid and brilliant advances of electricity. As a chronicler of the triumphs of this period—indeed, we may say as one of the potent agencies—the electrical press deserves at the present time at least passing mention. Its advance has proceeded step by step with that of the industry and science which it has represented with an enthusiasm unique in the history of journalism. It has served in turn as nursemaid to newborn ideas, as a strong arm when the first faltering steps have been made, as a protector in the period when support was still needed, and as an ally when full strength had been attained.

It is scarcely too much to say that the history of electrical journalism is epitomized in the course of the journal in whose pages this appears. Founded in 1874, when the telegraph was almost the only electrical application, it has seen, chronicled and nourished the advances which have given the name of the Age of Electricity to the latter part of the nineteenth century. When, in the year mentioned, the first number of the "Operator"—the precursor of THE ELECTRICAL WORLD—was issued, there were in existence but two other journals devoted to electricity—the "Telegrapher," which died three years later, and the "Journal of the Telegraph," then, as as now, the official organ of the Western Union Telegraph Company. At the present time there are published in this country six weeklies and three monthlies, covering more or less the entire field; two monthlies and one semi-monthly dealing with telegraphy; two monthlies dealing with the electric railway, one monthly with telephony, and three devoted to the interests of telegraphic and electric railway employees. During these years more than a score of other electrical journals have appeared and disappeared—some after a merely ephemeral existence and others after a manful struggle that at times in some cases seemed to assure permanent success. With the exception of a few of the more recently established elec-

trical journals now existing, none is at present conducted by its founder. As regards The Electrical World, its policy and management have, from the period of infancy, through the Sturm und Drang stage, and up to the present day, been directed by the same mind. Started with a capital of $100, and conducted through its first years with an economy that involved continual personal sacrifice, the "Operator" proved to be at all times fully up to the requirements of the state of the art. Though combining in his person the functions of editor, publisher and advertising solicitor, the proprietor did not confound them, and from the beginning established a reputation for fearlessness and independence in editorial comment that was more rare in earlier years than at present. With an application of energy and thought and a persistency of purpose that rarely have been bestowed on any enterprise, the result as shown in The Electrical World of to-day might have been anticipated.

The turning point in the career of the paper came with the sudden and numerous electrical developments beginning a score of years ago. Taking full advantage of the opportunity thus offered, the journal progressed by leaps and bounds until in a few years it ranked with the great professional and industrial periodicals of the world, which position has since been steadily strengthened. Though the growth of the journal has been coincident with the growth of the industry it represents—slow in the period prior to 1883, and since then by enormous increments—it does not follow that the success of the paper should be accepted as a matter of course. Many times turning points were reached when a lack of judgment or overweening self-confidence might have brought disastrous results. That for twenty-five years the course has always been onward and upward implies an expenditure of thought and labor which, gladly made by the donor, has not been unappreciated by those who have been, directly or indirectly, beneficiaries.

If "the man who leaves behind him a son better than himself is a benefactor of the human race," he whose efforts for a quarter of a century have been devoted to the upbuilding and uplifting of electrical journalism may, upon his retirement from this active field of effort, carry with him the consciousness that the work so long and so ably conducted by him will continue to produce results long after he shall have passed away.

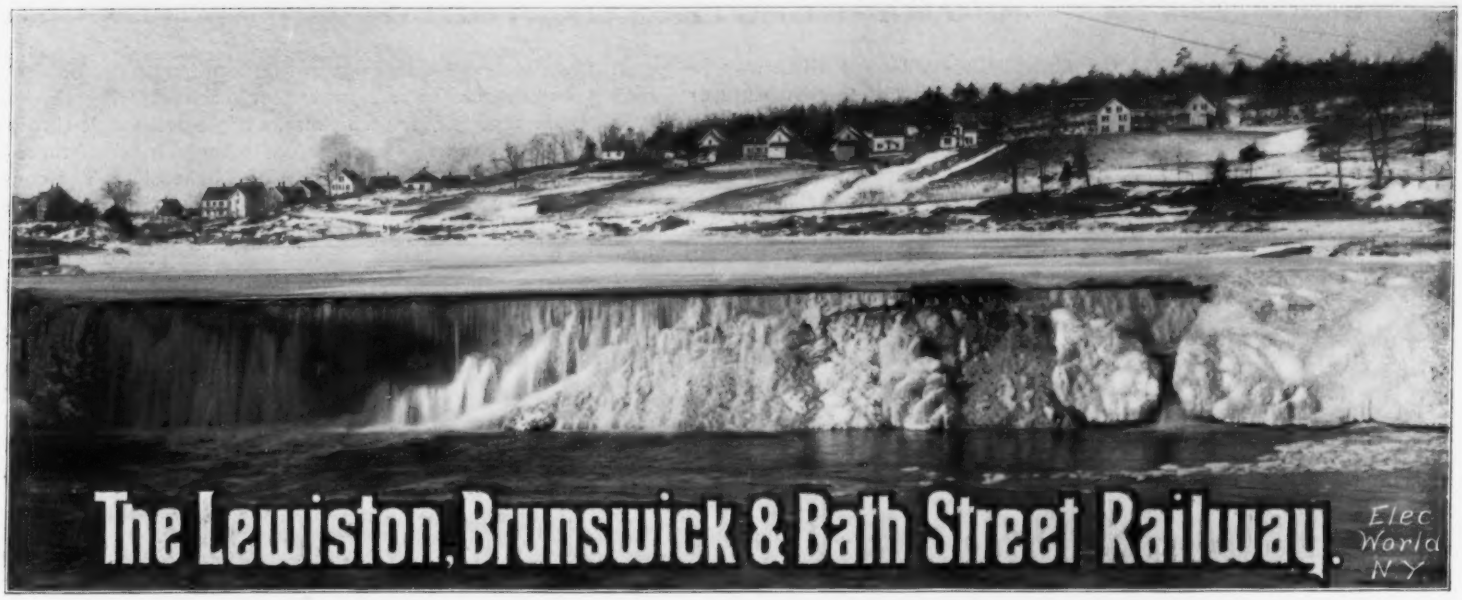
"DOUBLE-CURRENT" GENERATORS.

In the next few pages of this issue there may be found a description of an electric railway system in the power house of which there are in use machines of a novel type, in that they generate simultaneously alternating and direct currents. These have been termed in the engineering department of the company that built them double-current generators, a name which is not as precise as one might wish, but in place of which it is difficult to find a superior substitute. While these machines embody no new principles, or, in fact, no new details of construction, being simply rotary converters fitted with attachments such that they may be mechanically driven, their advent in commercial work marks another step in the advance which is being made toward the unification of electrical systems, and they promise to fill quite acceptably a long-felt want, both in railway and central-station work.

The operation of double-current machines with a frequency of 60 cycles per second is of interest to the central station, as well as to the electric railway, since 60 cycles is now the standard compromise frequency on lines intended for the supply of incandescent lights, alternating-current arc lamps and alternating-current motors. The management of those central stations supplying both alternating and direct current loads would do well to look into the merits of the double-current generator. The consolidation of the two loads on one type of machine should do away with much of the perplexity now existing as to which system is preferable, the new type of machine consolidating, so to speak, the two systems into one, allowing the use of direct currents with all their advantages for motors, etc., in the congested districts near the central station, and the supply of alternating currents to the more scattered loads at distances too great for low-tension feeding. Moreover, the addition of such a double-current dynamo to a central station already equipped with generators supplying both direct and alternating currents would give a machine which could be run as a reserve on either branch of the system, or could be connected to both in such a way as to in a measure interconnect them and equalize the load fluctuations. Moreover, at times of light load the generators supplying one of the systems could be entirely shut down, and this branch of the service supplied with power from the other through the rotary converter action of the double-current generator. Further, if a storage battery were in service on the direct-current lines, the new machine would immediately make its steadying and other beneficial qualities available upon the alternating-current system. Simple feeder regulators in the alternating lines would give means for independent regulation of the two kinds of current.

In this country there are not many combined central stations and street railway power plants, but in the few cases where this combination has been made its officers have been most enthusiastic in their advocacy of the benefits thereof. Naturally this is the case, especially in small places where the consolidated power plant of the two systems can be run with fewer attendants than the two independent plants would require, and where the increased load allows the use of many refinements and economies not obtainable in the two smaller stations. Such combined stations in this country have been worked entirely with independent generators for the two systems, and often with independent engines, the only real consolidation of the loads occurring at the boilers. In England a little better practice is followed by installing a motor generator between the lighting and the railway systems by which power can be transferred from one to the other at will. The double-current generator for combined alternating and traction loads is a long step ahead of this in that both loads may not only be carried by the one engine, but by the one dynamo. The objection which immediately occurs to any one considering such a plan is, of course, the effect of the fluctuations of the railway load upon the regulation of the lighting system. The best remedy for this trouble is the use of that acceptedly valuable auxiliary of all systems with variable loads, the storage battery, and, as noted above, the double-current generator makes the benefits of the battery immediately available on the alternating-current system.

The frequency adopted in the installation described seems unwarrantedly high. For a plant where, as in this case, all of the alternating current generated is transformed in rotary converters to direct current, the advantages of a low frequency outweigh those of a high. The former allows the use of machines for both generators and converters more closely resembling standard railway dynamos, while the latter necessitates high peripheral speeds, crowded poles, a short distance between brushes on the commutator, thin commutator segments and a high voltage per segment. The peculiarity of rotary converters whereby they have no field distortion, and consequent change of the plane of commutation, does not apply to double-current generators, which these disadvantages of a high frequency render peculiarly liable to "flashing over" from brush to brush. For these reasons, especially with such high direct-current pressures as 500 volts, it would seem to be advisable to bring the frequency in a plant of this kind below the lowest standard yet used in alternating-current work, namely 25 cycles per second, even to the extreme of coming down to the frequency of the magnetic induction in standard direct-current generators, namely, about 10 or 12 cycles per second.

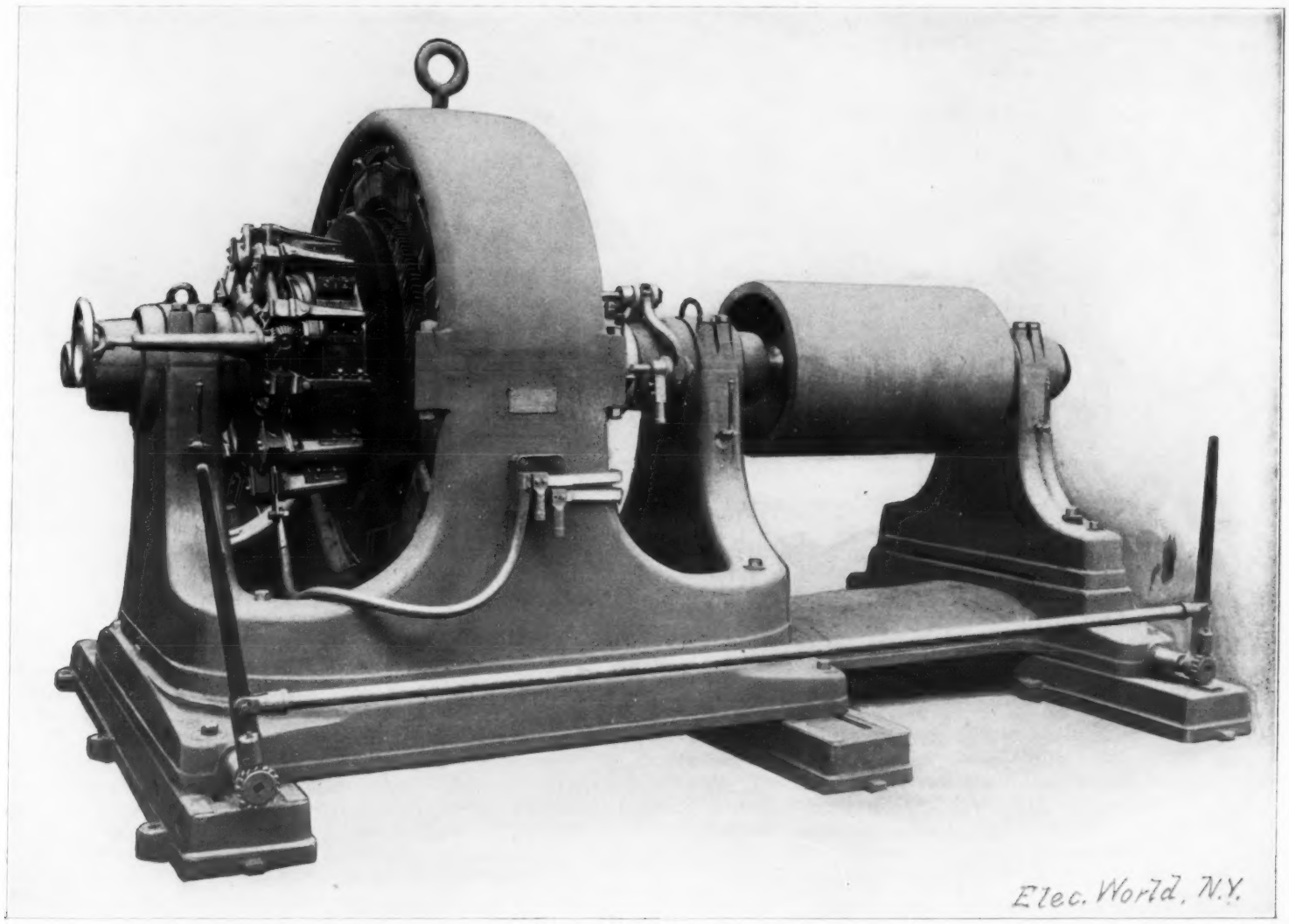


The Lewiston, Brunswick & Bath Street Railway.

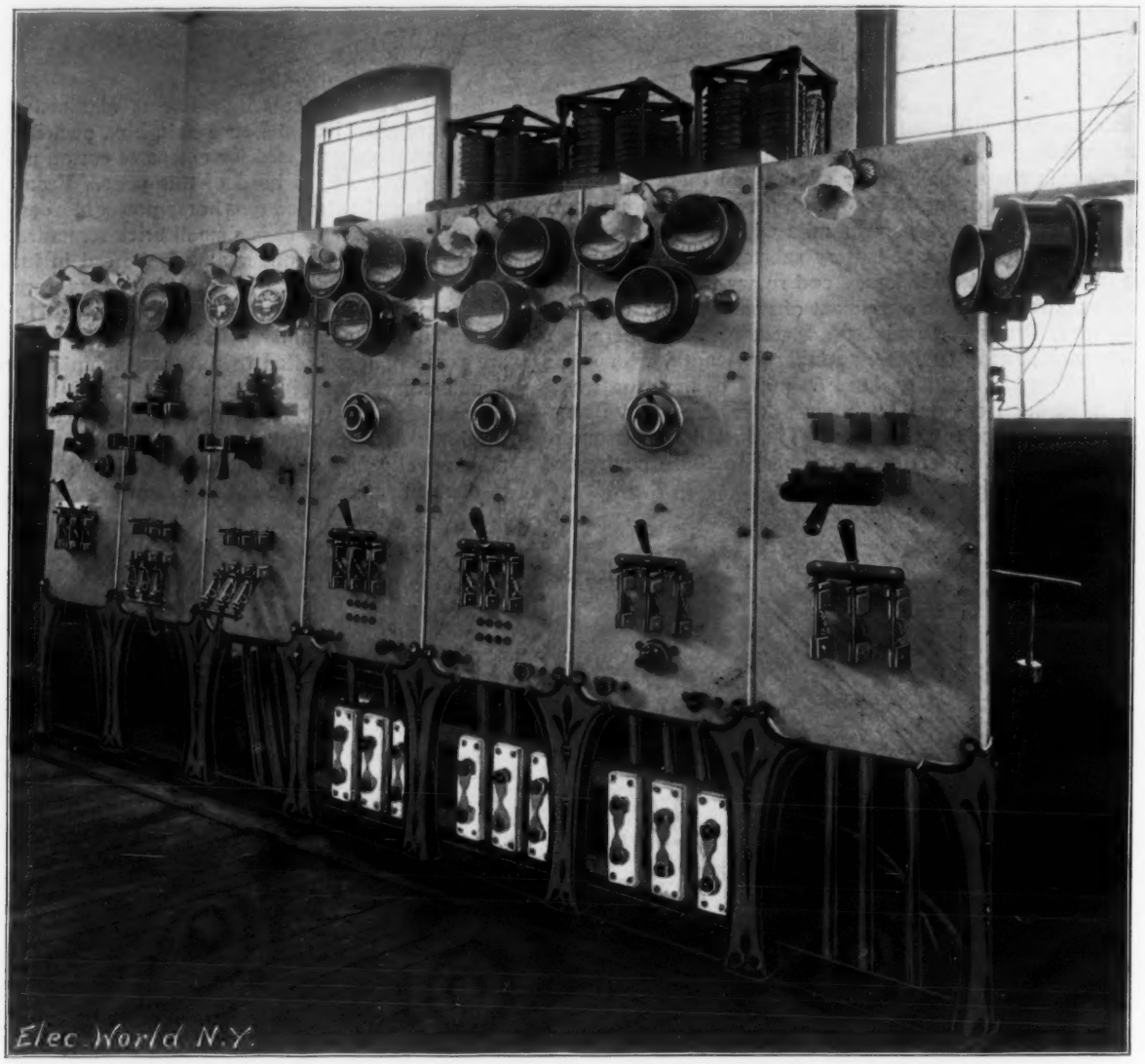
One of the problems most perplexing to the managers of street railways in cities of medium size is the supply of power to extensions or interurban cross-country lines, running more than 10 miles from the power house. Small power stations on these extensions are out of the question, owing to their high first cost, low economy and high operating expenses per car mile with the few cars they can reach at 500 volts. Storage-battery substations are somewhat better, but involve considerable losses, and rotary-transformer work has hitherto required a double equipment of generating machinery.

The Lewiston, Brunswick and Bath Street Railway operates a main line from Lewiston to Bath, 30 miles in length, with urban branches at both ends, making about 60 miles of line, the whole supplied with power from one hydraulic power station in Brunswick, and from one type of generators. The installation is one of the first of its kind, and therefore of interest to those confronted with the problem mentioned above.

The power for the whole line is obtained from a fall in the Androscoggin River at Brunswick, Me., owned by the Cabot Company, and largely utilized for extensive cotton mills. A view of the dam is shown at the head of this page. From this company the street railway has leased 1000 horse-power at a cost of $10,000 per annum. The power plant is a small brick structure near the mills, the water being utilized under a 17-foot head in four Victor turbines, all mounted on the same shaft, which runs a rope drive to the main countershaft. The wheels are controlled by Lombard governors. Mounted on the countershaft, and driven through friction clutches, are three pulleys bolted to the three main generators. These are double-current machines; that is, they deliver simultaneously from one winding both alternating and direct currents, being the first machines in this country to be used in this way. On account of their novelty they will be described in considerable detail. A view of one of them is shown at the foot of this page.



They are each rated at 250 kilowatts, the whole of which may be delivered through the commutator at one end of the armature or the collector rings at the other, or in any proportion through the two simultaneously. The number of poles is twelve, and the speed is 600 revolutions per minute, the alternating current delivered, therefore, having a frequency of 60 cycles per second. The direct-current voltage is 500 to 550, the alternating three-phase running from 300 to 330 volts, as it comes from exactly the same windings. Owing to the frequency adopted the peripheral speed is necessarily high and the poles are close together, so that the machines resemble 60-cycle rotary converters more than they do standard railway generators. In fact, the machines are almost identical with rotary converters of the same frequency and voltage, the only difference being the use of a pulley and an outboard bearing which have been added to these machines in order that they may be mechanically driven. Structurally, their design follows closely the standards of the Westinghouse Electric & Manufacturing Company, by whom they were built. The laminated poles are cast into iron yokes, and fitted with a compound winding, giving the standard variation from 500 volts at no load to 550 volts at full load. The winding is of copper strap, and the straps in each slot are gathered into two cells. The machines are guaranteed to stand a 50 per cent. overload for three hours.



The Switchboard of the Generating Station.

The switchboard is, of course, special, being made up of direct-current generator panels and alternating panels. There are at the left-hand end, as shown in the accompanying illustration, three of the former, each carrying the usual circuit breaker, ammeter, pilot lamps, volt-meter receptacle and triple-pole quick-break main switch. There are two direct-current voltmeters, one connected straight across the bus bars and the other to the plug receptacles. There are no field rheostats on these panels.

To the right of these panels are three others, one for the alternating-current side of each generator, each carrying three alternating ammeters, one for each phase, a triple-pole single-throw main switch for throwing the machine on to the one set of three-phase bus bars, and also the field plugs and field rheostat. The construction of the latter is in this plant novel, containing as it does two concentric hand wheels operating contacts on two face plates behind the board. The larger of these cuts in or out coils of the iron-clad cell type, and the other helical wire coils of a smaller resistance, to give a finer adjustment of the field excitation than can be obtained by the main rheostat. The machines are self-exciting. Below each panel are three cutouts with aluminum fuses connected in the machine leads. The one set of bus bars goes to the seventh panel at the extreme right-hand end of the board, which is known as the load panel, and contains simply two triple-pole switches, each supplying current to a three-phase group of transformers in the transformer house nearby. Bracketed to the end of the board are two alternating voltmeters, one of which is permanently connected between two of the bus bars and the other connected to receptacles on the alternating machine panels, by which it can be made to indicate the voltage on any phase of any machine. The a. c. panels are each fitted with two synchronizing lamps, which are owing to the low voltage connected up without transformers. Each of these two lamps is connected in series with two others behind the panel, all of these lamps being arranged with a plug in the usual method adopted by the Westinghouse Company. Each panel synchronizes with the bus bars. There are, of course, no ground detectors on the board, as the winding is grounded through the direct-current end.

From the switchboard the alternating current passes through lead-covered cables in an underground conduit to the transformer house, 45 feet away. This is a two-story brick structure about 18 by 24 feet

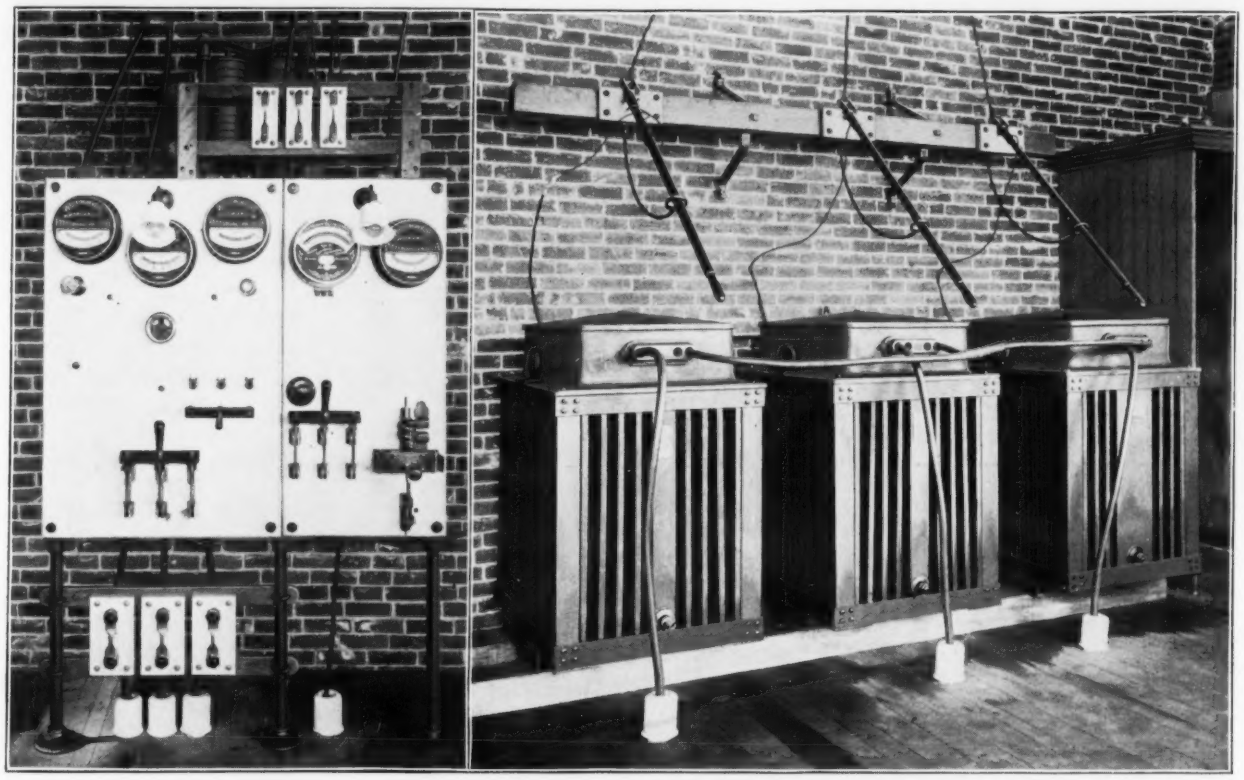
in size, its isolation being occasioned by the high pressure, 10,000 volts, generated within it, and the insurance requirements due thereto. In it are six Westinghouse oil-insulated self-cooling transformers, each rated at 125 kilowatts, with a ratio of transformation from 208 volts to 5980. Both primaries and secondaries are star-connected, giving from the machine pressure of 330 volts a line pressure of about 10,000 volts. From the low-tension windings of each transformer there are brought to the terminal plate inside the cover two taps, one cutting off from one end of the windings about 6¼ per cent. of the turns, the other cutting off about 12½ per cent. By connecting the leads to either one or the other or both of these taps, instead of the terminals, 6¼, 12½ or 18¾ per cent. of the low-tension windings may be cut out of service, and the ratio of transformation changed in the corresponding proportion. One tap is also brought out from the high-tension winding in order to give, when desired, a lower line pressure than that with all copper in. By means of these taps the ratio of the trolley voltage at the generating station to that of the trolley voltage at the substation may be changed by a few moments' work.

Leaving the step-up transformers, the high-tension lines are run to 10,000-volt switches, consisting simply of plugs mounted on the end of wooden poles about 36 inches long with flexible cord connections, the plugs entering brass sockets with spring contacts mounted on marble slabs. From these switches in the lower story of the transformer houses the circuits run through fuses upstairs and to a quadruple equipment of similar plug switches, by which either group of transformers or both may be connected to either one or the other or both of the two outgoing lines. Each fuse consists of two triple-petticoat porcelain insulators with brass fixtures mounted on their tops, between which runs an aluminum wire about a foot long in a soft rubber tube. The fuse wire is horizontal, and when it melts the soft rubber tube falls, giving a clean break. The lines are protected by Wurts type-R lightning arresters.

Of the two high-tension lines one runs 10 miles to the city of Bath, and consists of No. 6 wire. The other runs 20 miles to the city of Lewiston, and consists of No. 1 copper wire as far as Lisbon Falls, where there is a rotary substation, and No. 3 copper wire for the balance of the distance. The lines are put up on small porcelain insulators of the type designated No. 3 by the Imperial Porcelain Works. The three wires are mounted on a single standard four-pin cross-arm at the upper end of the same poles, that carry the brackets supporting the trolley wires. The circuits are not transposed or spiraled at any point.

The substations are three in number, the one in Lewiston having two 200-kw rotaries fed by three 150-kw transformers. The other two stations have each one 200-kw rotary converter, fed by three 75-kw transformers. The incoming high-tension lines are protected by Wurts type-R arresters, and run through plug switches and fuses similar to those described above. The transformers are of the oil-insulated self-cooling type, having the same ratio of transformation as the generating transformers, namely 208 to 5980 with all copper in and similar taps to give other ratios, the three being connected in the star or Y grouping.

The substation switchboard shown on this page consists of two panels, one for the a. c. and one for the d. c. end of the rotary. The former contains two synchronizing lamps with plug, the field rheostat, the triple-pole main switch of the alternating circuits and a smilar switch for the starting motor. The main fuses are below the panel and the starting motor fuses above. The other panel contains the usual d. c. voltmeter and ammeter, main switch and circuit breaker, the voltmeter being a centre-zero Weston instrument in order to determine whether the field of the rotary has built up with the right or wrong polarity to line. The outgoing 500-volt feeder is protected by a Wurts tank lightning arrester. The converters are 10-pole machines, running, therefore, at 720 revolutions per minute with practically the same winding and details as the generators described above. Overhanging the bearing at one end is a small three-phase induction motor for starting the rotary, and overhanging the bearing at the other end is a pulley, by which the machine may be driven by a steam engine, which will be installed later for emergency work. The induction motor is wound to give a high torque at standstill, with a smaller number of poles than those of the rotary, so that with the slip caused by the friction of the machine it will bring the speed up to a point slightly higher than synchronism, passing synchronism very slowly, thus giving a good opportunity for closing the main switch.



THE SWITCHBOARD AND LOWERING TRANSFORMERS IN THE SUBSTATION AT BATH.

There are no feeder regulators or boosters for obtaining an independent regulation of the a. c. and the d. c. pressures, other than the automatic regulation described below. To obtain over-compounding of the voltage at the distant substation, the rotary converters in each are fitted with a heavy series winding, designed to give a variation of pressure from 500 volts to 625 volts, with no load and full load respectively, were the machines used as mechanically driven generators. The rotary shunt fields are normally so adjusted that with no direct-current output the machines take an input of about 150 amperes per phase of lagging current to keep up their excitation, thereby causing a considerable drop of voltage in the alternating-current system, and a considerable reactive drop in the

double-current generators. As the direct-current load on the rotaries builds up, the series field winding increases the excitation, doing away with the lagging current in the alternating system, diminishing the reactive drop in the line, transformers and generators. With the rotaries heavily loaded, their field excitation is so great that a considerable leading wattless current flows, giving a rise of voltage in all inductive parts of the system, and thereby compounding, or over-compounding, the pressure at the rotaries. The same action obviously makes the alternating load upon the double-current generators affect to only a very slight extent the strength of the fields, since, when the energy load is small, the reactive demagnetizing action of the wattless currents is large, while, when the amount of energy drawn is heavy, tending to demagnetize the fields, the wattless currents become leading, tending to balance in part the field demagnetization. The same ensemble tends to render the substation voltage to a less extent dependent upon the direct-current load upon the double-current machines. The over-compounding of the generators builds up naturally the electromotive force impressed upon the alternating three-phase circuits, which, in turn, causes a greater lag or lesser lead in the wattless or magnetizing currents going out to the rotary converters, increasing the reactive drop in the line and transformers, and rendering the voltage delivery more nearly constant than that impressed.

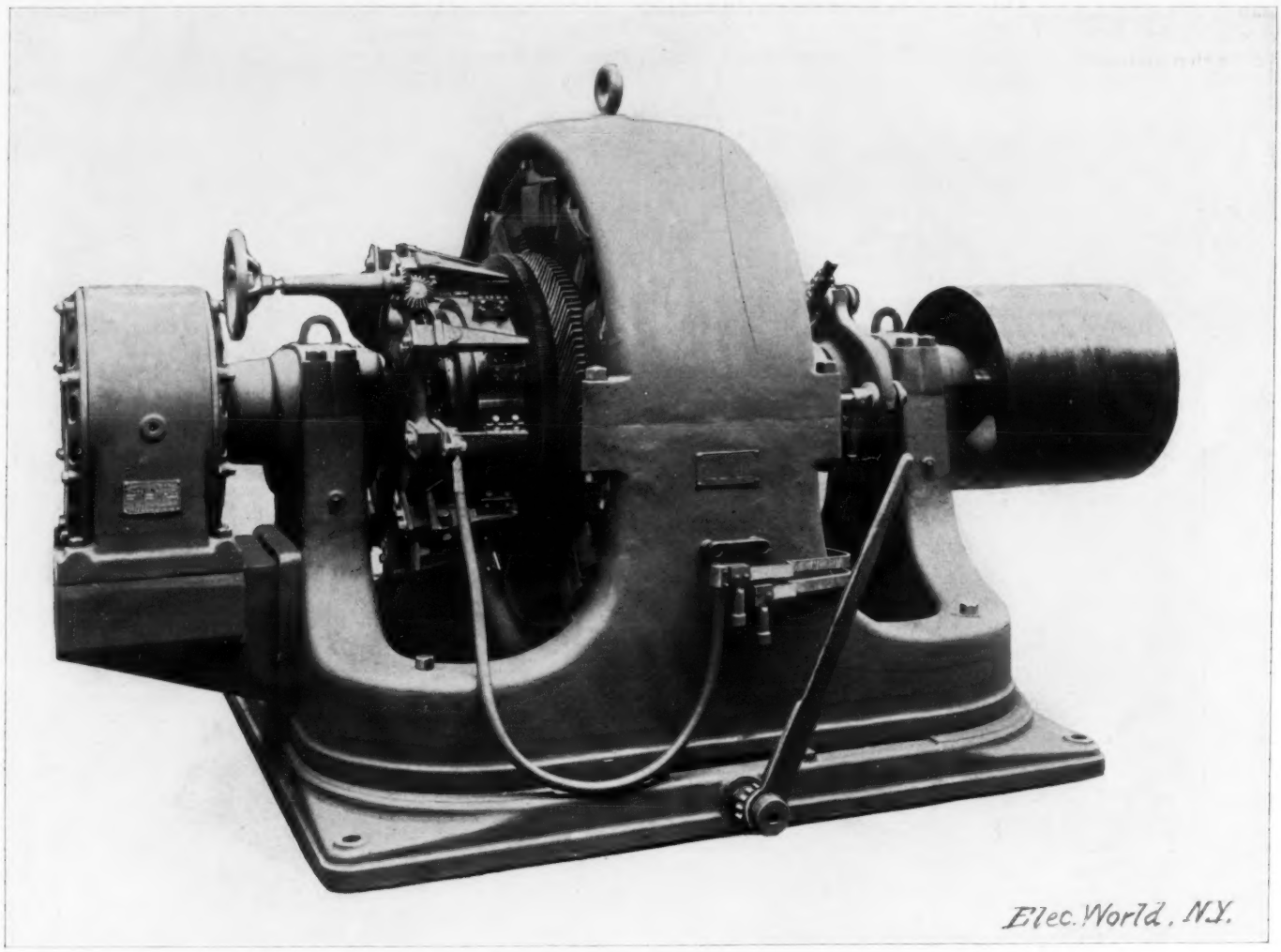
The main line consists of a single track laid with 60-pound T rails in 60-foot lengths. About 7 miles is on private right of way 2 rods in width, the balance following the side of the highway. The country is quite hilly and the track follows the contour, its maximum grades being about 8 per cent. One 0000 feeder is carried the whole length of the line, constituting a distributing main or side feed. The feeders as well as the high-tension lines are of bare copper wire. The section breaks are short-circuited through switches on the poles, thus tying all 500-volt copper together.

The main line traffic in winter is carried by nine single-truck cross-seat cars, giving a half-hour service, the run of 30 miles being scheduled at 2¼ hours. Each car makes four round trips, aggregating 264 miles per day, with a change of crew each round trip.

The through fare on this road for the 30 miles is 35 cents, the route being divided into seven sections, with fare of 5 cents per section. It has entered into an agreement with the Kennebec Steamboat Line, running from Bath to Boston, to carry through passengers, freight and express matter, and will put on special cars for the carriage of baggage and other inanimate traffic.

The officers connected with the line are: President, Mr. A. H. Shaw; treasurer, Mr. I. C. Libby; general manager, Mr. A. F. Gerald; and general superintendent, Mr. I. L. Meloon, to whom thanks are due for the information given above.

The electrical apparatus was installed under the general direction of Mr. E. Chesrown, representing the Westinghouse Company, who lately left to take a position with the Snoqualmie transmission plant, in the State of Washington. His successor is Mr. W. G. McConnan.



One of the Rotary Converters.

Exhibition of Electrical Appliances in Brussels.

At a meeting held January 20 by the Belgian Society of Electricians it was decided to open an exposition of all sorts of electrical appliances applicable to domestic uses. The exposition will be held next May in the new post and telegraph office, Brussels. It is the purpose of the society to make a complete exhibition of the various uses to which electricity may be applied in the household. Besides appliances for illuminating purposes, there will also be exhibited small motors for operating dumb waiters, cleaning and polishing shoes, heating kitchens, cooking stoves, bathrooms and bath tubs, electric teapots, sad irons, domestic telephones—in fact, all appliances operated by electricity, with a view to the total suppression of the use of coal for domestic purposes.

It would seem, from the number of water power and electric transmission plants now in operation, under construction or proposed for the Alps, that every available fall of every stream and rivulet would soon be utilized. The electrical engineer traveling to Switzerland might expect, from what he has read, to see the hillsides dotted with power plants and the land a network of canals; penstocks and high-tension transmission lines; but there are many mountains among the Alps, each, as a rule, with several streams, and each stream may have several available falls. The plants are, as a rule, small, and the demand for power considerable, owing to the high cost of coal and the many scattered manufacturing establishments. For these reasons the installation of more power plants in the Alps will probably continue to prove profitable for a long while to come.

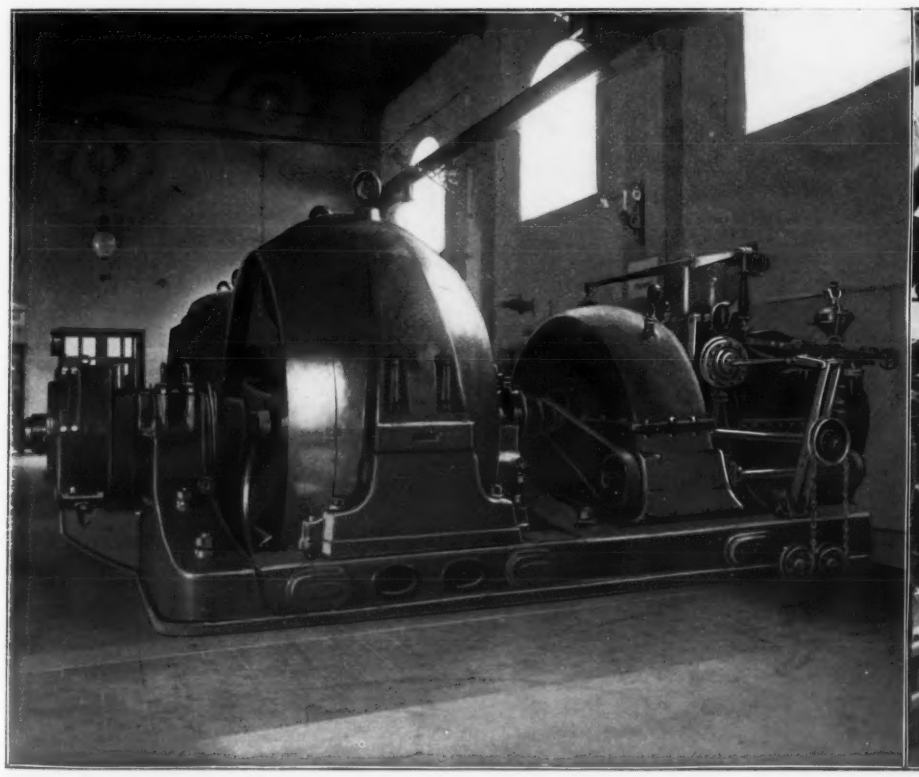
One of the latest is situated in the Tyrolean Alps, in Western Austria. The power used is that of the River Etsch, and the load is the lighting and the distribution of power in small units in the towns of Meran and Bozen. The power house is situated upon the river front, about 3 miles from the former place, where the river has an average fall of about 7 per cent. By the construction of a head ditch 1000 feet long, down the valley, running into a tunnel about 1800 feet long, where the valley becomes too narrow for both river and open flume, an available head of 215 feet is obtained at the power house beside the river and close below the outlet of the tunnel. The water is deflected from the river by a concrete dam capped with wood, running diagonally across the stream, and is led through a short canal to a reservoir nearby. The side of the reservoir next the river is provided with waste weirs, and near them is located the rack and gate through which the water enters the head ditch.

The head race is an open canal, with cemented walls, and is carefully fitted for the separation of all sand and pebbles, so that they shall not reach the water wheels. Besides the rack at the head gate, there is another at the mouth of the tunnel, at the other end of which the canal is broadened out to diminish the velocity of the water and allow all the material that has passed the two screens to settle. From the forebay the water is carried through two steel penstocks, over 5 feet in diameter, to the power house at the river's edge below. The hydraulic plant has been constructed to handle from 8 to 9 cubic metres of water per second.

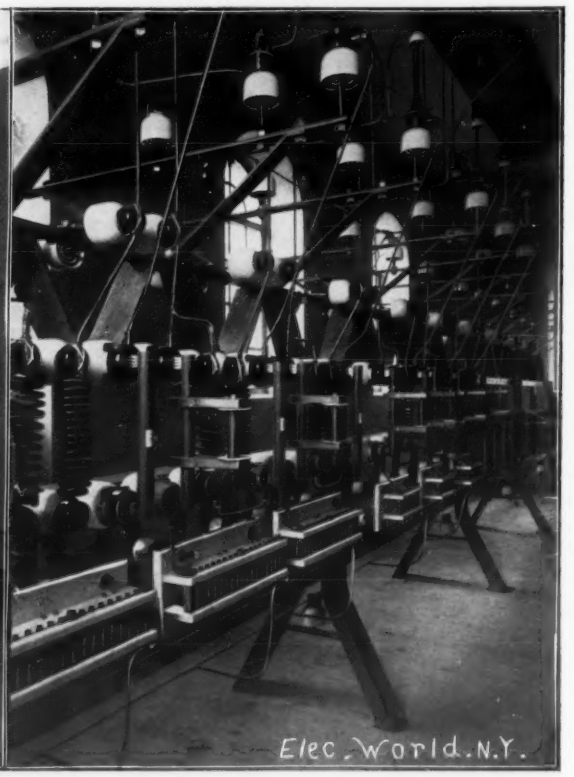
The power house, a view of which is shown at the head of this article, resembles in appearance a country residence built of stone. It is constructed to accommodate six direct-coupled generating sets of 1200 horse-power each, and since one set is intended as a reserve the rated output of the plant, when complete, will be 6000 horse-power. Four generating units have already been installed, of which two furnish current for lighting and power in the cities of Meran and Bozen, the other two supplying current for a calcium carbide factory nearby. Two more generators for lighting purposes are to be installed in the course of the next year.

The water wheels are of the Girard type, with horizontal shafts, and with hydraulic governors, furnishing 1200 horse-power at open gate, with the normal head, when running at their rated speed of 320 r. p. m. They are coupled to three-phase machines of the inductor type, rated at 800 kilowatts each. The greatest peculiarity of these machines is the use of two windings to give two separate voltages, one of them quite high for direct generation. The two dynamos supplying current for carbide manufacture are wound for a pressure of 3600 volts; the other two—that is, those used for lighting—give both 3600 volts for the short transmission to Meran and 10,000 volts for delivery to the more distant load at Bozen, 20 miles away. The high-tension switches, instruments, etc., inside the power house are mounted on supports with a high insulation resistance, consisting of regular porcelain line insulators. A view of lightning arresters, choke coils, switches and enclosed fuses so mounted is shown in one of the accompanying cuts.

At the end of the 10,000-volt line, and in a suburb of Bozen, is a



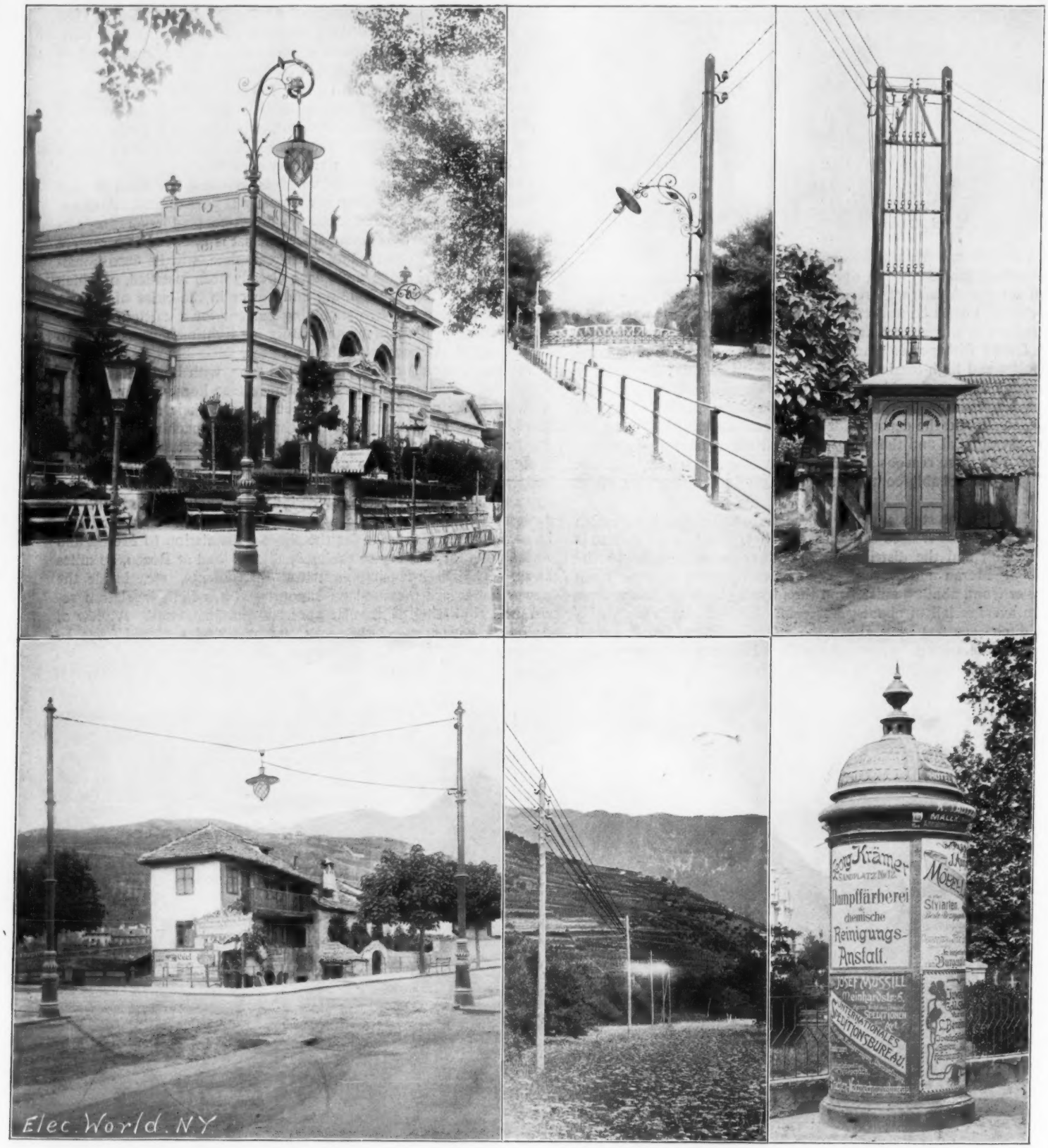
THE GENERATORS AND TURBINES.



THE HIGH-TENSION SWITCHES, ETC.

transformer station which steps the pressure down to 3000 volts, which is the normal voltage of the primary distributing systems in both districts. The power is again transformed to 115 volts, and distributed at this pressure over a secondary distribution system, by multiphase transformers, which are placed in placard columns, small ornamental wooden structures, or other buildings especially adapted for the purpose, scattered throughout the area supplied. Views of some of these and of the lines supplying them and the lamps and fixtures supplied from them are shown in the accompanying illustrations, which exhibit well the taste and artistic care taken in their design. The secondary network in both cities consists almost entirely of underground cables, overhead lines being used only in the suburban districts.

The street lighting of both cities is supplied from this hydraulic plant, consisting of 83 arcs and 770 incandescent lamps, the latter of 32 candle power. The premises of private customers have already been wired for some 22,000 incandescent lamps. Small motors are connected directly to the 115-volt network, but those rated at over 3 horse-power are supplied with separate transformers from the primary or 3,000-volt lines. The rates for light and power are fixed upon a sliding scale, dependent upon the daily average number of hours' use, further effort to smooth out the load curve being made by giving a lower rate for motors not used during the lighting hours than for motors used at any time. The plant was built at the expense of the two cities, all the electrical apparatus being furnished by the firm of Ganz & Co., of Budapest.



Views of the Lines, Transformer Stations and Lamps at Meran and Bozen.

The Motor Vehicle in Commercial Operation.*

BY G. HERBERT CONDICT.

We are told that about 2500 years ago there lived a prophet, Ezekiel, who had a vision, and in this vision he saw some marvelous wheels. Without attempting to determine what was meant by the vision, let us appropriate his statement regarding these wheels as a text for this talk on the horseless vehicle. "For the spirit of the living creature was in the wheels." What an apt and concise description of the vehicle which, having discarded the "living creature," the horse, still moves on with his "spirit."

We are but just entering a new era in the art of transportation; as the advent of the electric car brought a revolution in local rail transportation, so the advent of the road vehicle which goes without horses has commenced its triumphant campaign. Having come out victorious on the rail, the horseless forces are now gathering for the battle on the road. Even the Tammany brave is putting on his war paint and is thirsting for the fray. The "trolley buggy" is "the thing" and the "hay-motor" "sees his finish."

As we all know, the use of the horseless vehicle abroad far surpasses the little that has been accomplished in this country, but oil and steam furnish the power almost exclusively, and the electrics are in the meagre minority. With oil, gas and steam motors counted by the thousands, the electric foots up only by tens. Far different is the case on this side of the ocean. Oil, gas and steam vehicles are few in number and there are not 150 electrics in actual service. Yet there is no room for despair, for the Yankee rig, especially the electric, has already made an enviable reputation for itself and promises to distance all comers.

Only two or three remarks can be made here regarding the relative merits of the various forms of power used to make the wheels go round. Undoubtedly there will be discovered a place for each system in which peculiar adaption to local conditions will render competition in that particular field, by less favored rivals, improbable. I am not referring here to the light pleasure vehicles engineered by the owner, who, as a general proposition, cares comparatively little what the cost of operation amounts to, but to that business affair that is to carry you and your goods to and fro in all conditions of weather—rain, shine, snow and sleet—within the narrow confines of the city streets. It was the raging blizzards of the present season that served more than anything else to bring into prominence the motor vehicle, which ventured in where horses feared to tread and, in spite of all prophecies to the contrary, got out again with ease. It is in such service that the future of the automobile is to be filled with glory.

City transportation must be carried on with as little interference to the rights and comforts of others as possible. No motor depending in any degree on any of the products of petroleum is free from disagreeable odor. The principal streets of Paris, where the oil motor holds sway, are filled with the offensive odor so inseparable from the oil-well districts of Pennsylvania. A trail of unsightly vapor accompanies the onward march of the steam motor, particularly in cold weather. Vibration produced by the reciprocating parts of many motors is very disagreeable, especially when they are operated slowly and stopped and started frequently, as in municipal service. But the electric, noiseless, odorless, vaporless, operating without jar or vibration, surely it has found a field in which its virtues can shine without fear of the dimming shadow of a close rival!

In the crowded, narrow streets of the city it excels in all that goes to make up a mode of transportation void of offence, but some one says that the electric is a great, heavy, cumbersome thing. Yes, it is. That is the fault of our storage-battery friends. The battery is the "champion heavy weight" of the electrical fraternity. It is a case of full weight for the money, when you buy one. But no one buys a motor vehicle by the pound, and it does not make any particular difference what the weight is if the thing performs successfully and economically the work for which it was fashioned. In this connection it is often necessary to remind the critic that in comparing the horse vehicles and the motor vehicles the weight of the horse or horses must be included in the weight of the former. Of course, we all know that the moving of weight calls for more expenditure of energy, and unless this expenditure is offset in some other direction, the system having the burden must fail. If the heavy vehicle can transport a passenger or a ton of pay load from one point to another in a more acceptable manner than a light vehicle, the former does the business. At this time it is impossible to obtain reliable data for the comparison of cost of operation of the various systems now on the market. Figures made up from absurdly inadequate data have been published from time to time, but so far nothing of much value is known on this point. By "cost of operation" I mean the total expenditure in cash for fuel, oil, attendance, repairs and replacements of parts for a period of sufficient length to secure a fair average. Such observation should extend over, at the very least, a year, and there has been no commercial operation of any magnitude in this country or any other for any length of time. In Europe, in spite of the fact that thousands of automobiles are used for pleasure riding, there is to-day only one cab station in actual operation, and a few light delivery wagons, with here and there a lumbering steam truck, or a fear-inspiring omnibus. In this country a few cabs operated from one little station, and perhaps a dozen delivery wagons. In spite of the almost unqualified success of these few vehicles, we know them to be far from perfect, and, more than that, we know how to make many most important improvements. The most unexpected demand during the last few weeks for the electric cab in this city has given it a test which years of ordinary intermittent operation could not furnish. Its faults have glared out prominently, its virtues have shone in a brilliant manner, and as one of our daily "contemporaries" says, "In all its picturesque ugliness, the automobile is a boon and a blessing. * * * We not only give it our respect, but our admiration. * * * The gentle horse has had his day." Having covered over 250,000 miles of actual and commercial service, the vehicle has proved itself no longer a toy to be played with by the wealthy, but a practical thing, which is to come to the aid of the dwellers in our great cities, who are anxiously beholding the vast congestion of traffic in the streets and wondering what is to become of it in the future. The modern Rip Van Winkle goes to sleep for much less than twenty years, and when he awakes what does he behold? The streets of the city are clean (!), no rails cut up the smooth surface, no horse or any other beast is here; they are prohibited within the city limits. The pedestrian wends his quiet way along the sidewalks elevated to the second story and bridges over the street, while below the agile electric darts at good speed back and forth on its noiseless, easy-riding pneumatic tires, carrying all manner of humanity and its goods and chattels, and delivering them, not at the curbstone, but at the doorstep. The "living creature" has departed, but his "spirit is in the wheels." The elevated train, the cable and the trolley car have disappeared, but far below the surface glides the electric local and express in light and well-ventilated subways. The streets, made wider by the absence of sidewalks on the same level, allow a free movement of vehicular traffic, and the second-story stores are free from the dirt and turmoil now so overpowering.

And now for a moment let us consider the electric vehicle station in New York city, the first in the world in which the batteries are transferred by mechanical means entirely, the whole operation being under the control of one man standing on the platform of the electric crane. The men who organized the company looked at the crude and inefficient apparatus which was at their disposal, and saw in it the possibilities of a great industry. They decided to put sufficient capital at work to develop their ideas, and the present success of electric cabs bears abundant testimony to the wisdom of their decision. This station was equipped with the most approved battery-handling apparatus then obtainable, and no expense was saved in the very latest improvements in all of the various parts which go to make up a vehicle which could be depended on to do the work required of it. The supply is so absurdly inadequate to fill the demand that operation is carried forward under great disadvantages, considering the many component parts that are altogether incomplete and experimental. It has been impossible to make accurate tests of the efficiencies of motors, batteries, gearing, bearings, etc., although such data are now being obtained. There is still much to be desired, and in future equipments most material improvements will be made.

Outside of the consideration of large weight in proportion to power delivered, the battery has been giving excellent service. Up to the present time there has been practically no expense for maintenance, and the old-time troubles of buckling, short-circuiting, sulphating and disintegrating are as yet entirely absent.

The tire situation is at present the absorbing subject of our day thoughts and night dreams. Were the streets in this great metropolis paved in an up-to-date manner, there would be compara-

*Paper prepared for New York Electrical Society.

tively little cause for anxiety on this score, but with the antiquated and despicable cobble the case is far different. Over twenty separate and distinct types of tires have been tried, or are to be tried, in the near future, and others will probably follow. Solid, single and double-tube pneumatic, cushion, clincher, sectional, protected and unprotected have all had, or are to have, a trial. Their faults are many, their virtues few, and we are still on the search. We have heard of some eminent authorities in the motor-vehicle field who say that the solid is the only tire. They are rendering judgment without full knowledge of the facts, and from a purely local standpoint. They are evidently not acquainted with the streets of Manhattan. A very satisfactory arrangement for broughams is that of rear pneumatics and front solids.

The wheels also require most serious consideration. The severe strains unavoidable in crossing railroad tracks and other inequalities, and running up against curbstones, speedily put out of service even the most substantial constructions. Everything, from the light and airy bicycle-wheel construction to the dish-pan wheels now so familiar on our streets, has been tried, and still there are more to follow. I mention these few items simply to indicate some of the most important and particular directions in which the work is progressing.

I have been asked by our worthy secretary to say something about the "auto-truck," that mysterious being fed on wind, and on the breath of "bulls and bears" and "lambs." The daily papers have been full of him lately, and why should I weary you with a repetition of how the poor truckman is to be benefited by the advent of this new beast, or how the world in general is to receive a blessing when he breathes? "This is the age of miracles," and "all things come to him who waits." We have been waiting a long time, and now possibly even compressed air will come to us on wheels.

The Thawing of Frozen Water Pipes by the Electric Current.

The severe cold spell of February froze many of the water-service pipes in the city of Madison, Wis., below the surface of the ground between the mains and the consumers' premises, to the great discomfort of those depending upon them for water, as the old-fashioned treatment in such cases requires extensive excavation, difficult in frozen ground. A better method was developed, and, according to press reports, applied with no little success by Professors D. C. Jackson and R. W. Wood, of the University of Wisconsin. The modus operandi consists of connecting one terminal of the circuit to the water pipes in the house affected and the other terminal to connections from the same water mains on neighboring premises, the circulation of the current through the iron piping generating heat throughout its length, which thaws the frozen part wherever it may be located. No data are available as to the current taken, but owing to the difficulty of locating and getting at frozen pipes by older methods it would appear that considerable trouble might be warranted in the temporary placing of special wires and transformers, so that this application may prove to be of quite general value.

Improvements in Combined Open-Conduit and Overhead-Trolley Railways.

Patent No. 619,783, issued February 21, 1899, to F. S. Pearson describes an automatic slot hatch or trap, through which the plows of cars running on open-conduit street railways may be removed from the conduit in order that the cars may continue on lines fed by overhead trolley wires. The hatch is automatically opened by a mechanism operated by a lever with which the shank of the plow engages at a level just below the slot. The hatch opens downward, being held against opening under heavy weights by knuckle or toggle joints. It is latched when open, so that the plow may be pulled up from the conduit, and the latch is released when the car moves on by the running of the car-wheel flanges over projections in the rails. The hatch is placed to one side close to one of the main rails, and the conduit and slot are deflected to this position in order that the plow may be raised under one of the side seats of the car. The claims on this improvement are very broad, covering generally the combination of a trap automatically opened by the plow or grip of the car.

Professor Rowland's Multiplex Printing Telegraph.

On February 24 a public test was made between Jersey City and Philadelphia of the printing-telegraph machine designed by Professor Rowland, of Johns Hopkins University. In general the principal features of this new system of telegraphy are as follows: The line currents are alternating and sinusoidal in character, of a uniform frequency, the changes of line condition for the transmission of characters being the omission of half periods of the alternating current. The line may be duplexed in the ordinary differential manner. Further multiplexing is obtained by successively devoting the line for brief intervals of time—each sufficient for the transmission of one character—to several machines in regularly recurring cycles. For instance, assuming that the line is worked, as was that in the test mentioned, with four machines transmitting in each direction, the rotating rosettes or commutators would synchronously transfer the circuits in regular order from one to another of the transmitting keyboards at one end and simultaneously from one to another of the receiving printing mechanisms at the other. Assuming, for the sake of illustration, that the apparatus were running at such a speed as to transmit from each keyboard at the rate of 240 characters per minute, which speed has been attained, the line would be devoted for 1-16 of a second to one machine, the next sixteenth to the second machine, the third sixteenth to the third machine, and the fourth sixteenth to the fourth machine, after which it would repeat the cycle. The time occupied in the transmission of a single character is that of ten alternations or five complete cycles of the line current; thus, with the speed assumed, viz., four characters to each of four machines per second, the alternating current in the line would have a frequency of 80 cycles per second. The different characters are distinguished by omitting one or more of the ten half waves in different combinations.

The transmission is manual, requiring, of course, at either end of the line with the number of machines assumed, four operators. Each of these has a keyboard fitted with forty keys. These keys interlock with ten contacts, the depression of any key operating one or more of these contacts, which in turn cause the omission from the alternating current sent out to line of the corresponding one or more waves. The keys of any one keyboard must be dressed regularly in time with the machine, and at a time when the transmitting rosette is picking up current from the other three transmitters. They must then be held down while the brush of the transmitting rosette or collector travels over the ten contacts connected with that keyboard. For this purpose the keyboard is fitted with a magnet, which prevents the operator from depressing any of the keys at the wrong time, and holds the combination of contacts last depressed until the collector has picked up the currents therefrom.

At the receiving end the line currents pass through a double-ended polarized Wheatstone relay, one armature of which is connected with the synchronizing apparatus and regulates a motor which drives the distributing rosette and the four type wheels in synchronism with the alternating current sent to line from the other end. The other armature of the relay is connected through the rotating distributor or rosette running synchronously with the collector at the transmitting end to the local selective relays of four type-wheel printers. There are ten of these selective relays for each printer, and the omission of a line wave and consequent omission of a movement of the line relay armature sets over the armature of the corresponding one of these ten relays. The combination thus set up on the armatures of the selective relays closes a circuit through one segment of a commutator on the type-wheel shaft. When the brush of this commutator reaches the segment of this closed circuit the printing platen is brought up against the type wheel recording a character, the paper is moved on, the local relays are restored and the machine is ready for the reception of another character. The type wheel is constantly running, and is not stopped for the printing of the letter.

The chief feature of the machine is the arrangement for maintaining synchronism, which is claimed to give very accurate and tenacious results. One synchronizing equipment drives all of the four wheels at one end of the line. Its details are not as yet given out. The apparatus shown only purports to be experimental, being constructed at the Johns Hopkins University. One of the type wheels shown is fitted with a page-printing device, the others being tape printers.

Electrolytic Processes for the Extraction, Separation and Refining of Metals—II.

BY DR. D. TOMMASI.

(Concluded from page 238.)

SPONGY LEAD.

The lead recovered from the electrolyzers is a spongy mass composed of minute crystals, which are very light and very plastic, and in this state it is an excellent active substance for accumulators of any known system, more especially for those on the Tommasi system, known as the Fulmen accumulators. Its plastic condition renders it easy of application to the electrodes of accumulators, and its fine state of division makes it a substance eminently suitable to be transformed rapidly under the influence of the electric current into peroxide of lead.

The spongy lead used by some manufacturers of accumulators is obtained by the addition of zinc to a solution of lead acetate. The lead thus obtained is not only more expensive than that obtained electrolytically, but it is far from being pure, since it contains the greater portion of the foreign bodies contained in the ordinary zinc of commerce, chiefly arsenic, bismuth and antimony, and the presence of these is detrimental to the good working of the accumulators and causes them to rapidly deteriorate.

As to the cost of production of a ton of spongy lead, it can approximately be taken from the following:

1832 kilogs. of lead acetate at 650 frs. a ton	1190.80 fr.
320 kilogs. of zinc acetate at 450 frs. a ton	144.00
(This is the theoretical quantity. As a matter of fact, at least, 500 kgs. are used.)	
Labor	20.00
	1354.80

The acetate of zinc formed having no industrial application, its commercial value is quite insignificant, in fact it is practically valueless.

By the Tommasi process a ton of chemically pure spongy lead would cost:

Lead anodes	250 francs
Cost of electrolysis	8 "
	258 francs

That is to say, in round figures, 260 francs.

The saving effected would thus be $1355 - 260 = 1095$ francs. Assuming an annual consumption of 1000 tons, the adoption of this process would lead to the saving of 1,095,000 francs.

LEAD CARBONATE. LEAD OXIDE.

According to the treatment to which spongy lead, obtained from the electrolyzer, is subjected, it is possible to produce either (a) Unoxidizable lead and

(b) Oxidizable lead { (a) becoming converted into litharge or minium, according to the temperature; (b) becoming converted into carbonate.

B. OXIDIZABLE LEAD.

When the electrolytic lead is acted upon by certain reagents it becomes easily oxidizable, and becomes very hot when in contact with air. The oxidation of the lead is nevertheless only partial, for it does not whiten, and remains in a grayish powder. This powder, composed of finely divided lead, does not melt when heated in contact with air, but becomes rapidly converted into oxide of lead. It will, therefore, be possible to obtain from electrolytic lead, massicot, litharge, and even minium, in a very pure state and very cheaply.

It is estimated that the cost of production of a ton of oxide of lead prepared by this process will not cost more than 20 francs, i. e., its price would come to 270 francs if lead costs 250 francs a ton, whereas litharge and minium, prepared by the ordinary processes, cost at least 400 francs a ton, from which it is seen that the Tommasi process leads to a saving of 130 francs.

In order to produce lead carbonate, i. e., lead becoming white when in contact with air, the lead obtained from the electrolyzers is submitted to a secret treatment in an apparatus, by the aid of which it is possible to deal with large quantities of the lead. It may be added that, this apparatus being hermetically closed, there is no fear of any carbonate of lead dust floating about in the air, as is the case in the ordinary manufacturing process, and which is so harmful to those employed in its preparation. By this new arrangement this operation is perfectly harmless.

When all the lead has been transformed into lead carbonate, it only remains for the product to be washed and dried on slabs of porous ware.

It would be well to estimate the cost of production of lead carbonate by the electrolytic prices and to see the saving effected by it over the ordinary process of manufacture.

The composition of lead and carbonate varies according to the process by which it is manufactured. The formula which most nearly corresponds to the ordinary commercial carbonate of lead can be taken as $4.P.CO_2, PO,H_2O$. From this formula, it follows that for the production of one ton of carbonate the amount of lead theoretically required would be 715 kilogrammes, practically 800.

We have already seen that the cost of production of a ton of electrolytic lead was at the most 10 francs, and consequently a ton of lead carbonate prepared by our process can be approximately estimated to cost:

800 kilogrammes of ordinary lead for making anodes, at 250 francs per ton	200 francs
Cost of electrolyzing	8 "
Cost of making lead carbonate	20 "
	228 francs

Lead carbonate made by the ordinary process costs about 430 francs a ton, taking the price of lead at 250 francs a ton. The saving in cost of production by our process would, therefore, be $430 - 238 = 202$ francs, say 200 francs a ton.

The method just described is not only eminently practical, but also very economical. It must, consequently, and in a very short time, take a leading place in the electro-metallurgical industry.

Improvements in Induction Meters.

Patent No. 619,734, issued February 21, 1899, to Thomas Duncan, describes some ingenious improvements in integrating meters of the induction type. One of these is a modification of the retarding device, the winged fan in air being replaced by paddles or blades revolving in superfine paraffin oil. This allows a much lighter construction with the same retardation; in fact, the total weight of the rotating parts may be hydraulically balanced. The jewel is also placed within the oil, insuring its perfect lubrication. Torque is produced in the disc of an induction motor, the rotating field being obtained by a series coil and an auxiliary coil, not shunted across the mains, but solely around the series coil, the greater number of turns of the auxiliary giving a higher self-induction and a consequent phase displacement; thus there is no constant waste of energy independent of the load as in meters with shunt coils connected across the mains. The patent states that this gives a torque which varies as the square of the current passing through the meter, the liquid brake rotating at a speed proportional to the square of the torque, thus giving the meter a straight-line characteristic. The specifications also state that on very slow speeds the resistance to motion of the liquid-retarding devices is somewhat less than exactly proportionate to the square of the speed, thus automatically correcting in part for the friction of the parts.

The Use of Electricity in Seasoning Wood.

According to the London "Times" there is in use at Messrs. Johnson & Phillips' electrical works a novel system of seasoning wood, which has been introduced from France. The timber is placed in a tank and nearly immersed in a solution of borax, rosin and carbonate of soda. Lead plates connected with the source of current supply are pressed on opposite sides of the wood, the current being used at 110 volts, and the consumption of energy being about one kilowatt hour per cubic metre of timber. Under the influence of the current the sap appears to be replaced by the aseptic borax and rosin, which permeate the pores of the wood.

Electric Heating of Cloth Presses.

At a recent meeting of the Industrial Society of Elbeuf a report was presented on a process of heating the numerous layers of cloth in the cloth presses used in French textile works, by means of interposed electric heaters in sheet iron. It appears that the method replaced consisted in the heating of cast-iron plates in a furnace, and their subsequent interposition between the layers of cloth in the press, a cumbrous and crude system, over which the electrical method naturally shows great advantages, both in ease of working and results accomplished.

The Advantages and Disadvantages of the Electrical Profession.

The electrical business, what inducements it has to offer to a young man for a life work and what branches of it are the most attractive from a financial point of view, formed the subject of a discussion Friday evening, February 24, at the Electrical Club of the Young Men's Christian Association, of Chicago. A symposium, made up from the opinions of many of the leaders in electrical work throughout the United States, was read, and an address delivered by Director George A. Damon, of the club. Following are an extract from the address and the symposium accompanying it:

The question is often asked "Do electrical occupations pay?" It was for the purpose of ascertaining facts which would indicate the answer to this question that the preparation of the following paper was undertaken:

The term "electrical occupations" may be made to cover a wide range, and so, for our present purpose, let us make it include every vocation in which a knowledge of any of the laws of electricity plays a necessary part. It is generally thought, by those not in the business, that electrical occupations offer more brilliant opportunities, quicker advancement and greater pecuniary rewards than any other line of work. As a result of this popular conception of the electrical business our technical schools (of which there are nearly seventy in the country) are crowded with young men preparing themselves for the profession of electrical engineering, while thousands of young men, who, through force of circumstances, cannot obtain a college education, are seeking to enter the ranks of electrical workers, through every available channel.

It is fair to assume that these young men, inspired by the many brilliant successes that have been made by electrical workers, are imbued with an ambition to become equally successful. Even if they do not become famous they have a right to expect, in return for the years of labor which they propose to devote to their chosen profession, not only a subsistence. but a pecuniary reward which will insure for them a fair share of the legitimate luxuries of life.

It is generally conceded that nearly every other profession is overcrowded. One of the questions of interest to the young man who already has or who hopes to take up some branch of electrical work is: "Has not the great rush of young men into the electrical occupations in the last few years overcrowded this branch too, and reduced my chances of success?" In order to obtain as broad a view of the entire field as possible the following letter was sent to a number of men of acknowledged reputation, who had attained success in their various lines and who were in a position to furnish the information desired:

"Dear Sir: The Young Men's Christian Association Electrical Club is composed of young men who desire to make a success in electrical work. On February 24 the programme of the club is to be an open discussion on 'The Electrical Business—How to get a start and does it pay?' Can you not arrange to be with us and take part in the discussion?

"Electrical occupations are supposed to be full of opportunities for bright young men, and we are making an effort to discover what and where the best chances are. With this in view we are endeavoring to collect some information in regard to the number of men employed in the different branches, as well as the salaries connected with each occupation. You will appreciate that this is somewhat of a task, which can only be accomplished by the hearty cooperation of all our friends, and we trust we may count you among the number. Will you kindly answer any or all of the following:

"1. How many men are employed in any of the following capacities by your company, and what is the average salary per week of each class of workers? Draughtsmen, chief draughtsmen, electrical mechanics, electricians, inspectors, armature winders, wiremen, erecting electricians, designers, repairmen, testing experts, salesmen, contract agents, superintendents, managers, dynamo tenders, battery attendants, metermen, troublemen, clerks, electrical experts, operating electricians, switchboard attendants, etc. etc.

"2. What branches do you consider offer the best opportunities at the present time?

"3. What branches seem to be opening up the largest opportunities for the future?

"4. Which pays the best—the technical side or the business end of the profession?

"5. Can a young man become an electrical engineeer without obtaining a college education?

"6. Does a college education pay if a young man is to be a journeyman?

"7. Would you advise your workmen to attend night school?

"8. Is it possible for a young man to get a start in your company without the use of influence?

"9. You have known a number of men who have not succeeded in electrical occupations. To what do you attribute their failure?

"10. Judging from your own and other successes what qualifications would you say were desirable for a young man entering the business to possess?

"11. What advice would you give to a young man with a sincere ambition to get to the front?

"Trusting that we have not asked for too much of your valuable time, we are,

"Yours sincerely,
"Y. M. C. A. Electrical Club,
"per George A. Damon, Director.

"Chicago, February 4, 1899."

The answers to questions received in the various letters have been tabulated, and will be presented in order.

In giving the information in regard to the salaries connected with the various branches occasion will be taken to add other facts which have been inadvertently gathered.

Draughtsmen.—Average salary about $2.25 per day. The draughting room is a good point of vantage from which to look over the field in any line of industry, and the young man of energy will stay but a few years in the draughting room before he will push out and assume greater responsibilities. The best draughtsmen are those who combine a knowledge of shop practice, methods of construction and principles of design with ability to draw rapidly and accurately. Such a man may become a draughtsman, and this occupation pays as high as $5 per day. But as one man expresses it: "If you draw well be sure you can do other things well also, lest you become a draughtsman for life."

Electrical Mechanics.—Electrical work is suffering from the lack of the old-fashioned apprentice system. Good electrical mechanics are hard to find, and the demand is steady. In special lines such as the telephone branches, good electrical mechanics make from $5 to $6 per day. These are men with an all-round experience who have level heads and well trained hands. On the other hand, there are hundreds of young men in Chicago slaving for a mere pittance of $4 to $9 per week, who are employed making or assembling the thousands of duplicate parts used in electrical apparatus. The manufacturer who can simplify his output so that it consists of a few parts made by automatic machinery and put together by cheap labor is the manufacturer who will outstrip his competitor, and as long as there are so many young men who are seeking to secure electrical work he will have no trouble in having the cheap labor. The electrical mechanic who devises a machine or develops a process which will require but one man to do the work which formerly required two or more men is sure of his reward. Foremen and superintendents of electrical machine shops get from $100 to $200 per month, and good foremen are hard to find.

Electricians.—There are electricians and electricians. The man who puts in a door bell seems to have the right to call himself an electrician, and when an occupation can be entered so easily it is hard to say how many there are in a city like Chicago, or what their average income may be. It is probably low.

Nearly every isolated plant of any size needs one or more electricians to care for the electrical machinery and lights and to make changes and extensions about the plant. This work pays from $12 to $15 per week. Electricians in special cases, such as telephone work, get as high as $30 per week.

Inspectors.—These are employed by the telephone and electric light companies. Their work is largely routine, and pays about $2.25 per day.

Armature Winders.—Such men were formerly well paid, but the addition of machine coils and slotted armatures has reduced the wages to an average of about $2.50 per day. Good foremen of armature winding departments get $3 to $4 per day.

Wiremen.—If a man is a fairly good journeyman wireman and belongs to the union in Chicago he will get the regulation $3.75 per day, but he will be exceedingly fortunate if he is not out of work over four months of the year. It will cost him $45 to join the union and $1 a month dues. No apprentices are allowed to work on union jobs, and most new work upon which other members of the trades union are employed is a union job. From the standpoint of the

union man, the union is a good thing, as the electrical contractors must figure on union wages, and the wireman gets the benefits. If every union man earned the $3.75 per day which he demands there would be few objections to the union. Outside of the union a wireman gets from $1.50 to $2.50 per day. A good foreman can be secured for from $3 to $4 per day. Erecting electricians are generally graduates from the factory whose product they install. They get from $75 to $100 per month. Electrical machinery is being bought more and more f. o. b. cars at factory, and installed by those in charge of the purchaser's plant. It is no longer considered necessary to have an expert from the factory to start a dynamo or motor, as was formerly the case, and there are fewer erecting electricians needed than formerly.

Designers.—The information received does not agree upon this occupation. One man says it is overcrowded, and therefore ability in this line is underpaid, while a certain manufacturer says he cannot find enough qualified designers. Dynamo designers as a rule get from $75 to $100 per month, although there are one or two cases in Chicago where a higher salary is received.

Repairmen.—Formerly electrical machinery showed defects in workmanship and material much oftener than is the case with recent types. It is now the case with modern generators and motors to operate month in and month out without the slightest expense for repairs, and when they are required they necessitate less skill than did the older forms. Repairmen are, therefore, much less paid then formerly, averaging about $15 per week. Money has been made, and will continue to be made, by the sale or exchange of electrical apparatus, and in this business a knowledge of the peculiarities of the existing forms and even obsolete types and styles of electrical apparatus will be of considerable value.

Testing Experts.—This is a high-sounding title, but the occupation carries but little salary with it. As a rule, the work of testing in the factory is given to ambitious young men who have a college education and a desire to learn the business, and about all they get out of it is a chance to attract attention and earn promotion to the erection or to the engineering departments. As a stepping stone to something better, the testing room is a desirable place, and any young man should consider himself fortunate if he has an opportunity in this direction. Chief testers are paid $4 to $5 per day, while special experts, such as are employed by the lighting companies for the purpose of testing transformers and transmission lines, are paid very well.

Salesmen and Contract Agents are paid, of course, in proportion to their worth, which is measured by their ability to close large contracts at good prices. It is generally conceded that these occupations pay better than the purely technical positions. Electrical salesmen and solicitors make from $65 to $200 per month, while the Western managers of some of the large electrical manufacturing concerns draw larger salaries. It was formerly thought that technical men who knew what they were talking about made poorer salesmen than non-technical men, who could talk fluently about what their machinery would do, without being aware that they were departing widely from the truth. But the methods of selling electrical apparatus are undergoing a change, and technical men are more in favor as salesmen. Salaries are steadily decreasing in this branch, and a good many formerly high-priced salesmen are working for less pay or else are out of a job altogether. Good chances seem to be opening up for manufacturers' agents who handle the sales of a number of specialties, any one of which would not pay to push alone. There is said to be a fine opening in the supply business for a young man of technical training, business ability and plenty of push.

Superintendents and Managers.—A large amount of executive ability with a broad technical knowledge makes a paying combination. Superintendents and managers are usually men who have grown up in the business and who have developed special aptitude along their particular lines. Their salaries may be as high as $150 to $200 per month. The electrical world is waiting for more and better managers than it has to-day, and is willing to pay for them when they develop. Every superintendent and manager of to-day will within a few years be replaced by a better one who is now being trained.

Dynamo, Battery, Switchboard and Meter Attendants may be classed under the routine workers. Their duties each day are very much like those of the previous day. Their work requires a faithful performance of duty, but they are called upon to use but few of their own ideas, and are, therefore, paid but about $12 to $15 per week.

Troublemen are usually developed from wiremen, and though paid about the same wages have the advantages of being insured steady employment.

Operating Electricians are the cool-headed fellows who keep the power station going and the distributing system in good order. They usually have an all-round experience, which has been gained by years of hard knocks. Their salary may be from $100 to $250 per month, depending on the importance of the enterprise they have in charge.

Electrical Experts and Engineers.—These are the men who are supposed to be getting the big salaries. If the truth were only known it will be found that many of them get more glory than pay. A man doesn't become an electrical engineer in a minute. Before he becomes recognized as an electrical expert or as a consulting electrical engineer a man must work hard for a number of years, and then, after he has attained a certain position, he must keep on working just as hard or even harder to keep his reputation. Work, work, work, is the key to success in this line, as well as in any other.

In answer to the second and third questions, it was generally conceded that the newest developments offered the largest opportunities. These were variously indicated as water-power development, alternating-current transmission, storage-battery work, electric inter-urban railway construction, electro-metallurgy, automobile work and the application of electricity to steam lines. One prominent consulting engineer puts it this way: "The largest opportunities for the future are probably in the operation of plants. I believe that if young men would fit themselves to do wiring, handle dynamos and a thousand and one things pertaining to the operation of a plant that they would find the surest and best opening for employment. The main trouble with the majority of young men to-day who are looking for employment in the electrical business is that they are looking entirely too high. They are trying to find some position where they won't get their hands dirty, and where they can draw several thousand dollars a year, telling people of things they have learned in the books, which themselves are ten years out of date." Another: "If a man likes his work, and is not lazy, you can't hold him down."

LETTERS.

"What branches would offer me the best opportunities?" The proper answer to this question will depend more upon your own case and ability than upon anything else. For the average graduate in an electrical engineering course I do not know that there is much choice between lighting and power work and tramway work. I would advise you to decide which of these is most agreeable to you and then push ahead and get all the information possible regarding your specialty. The competition in any branch is very keen, but at the same time there are places in every department for thoroughly competent men.

L. B. STILLWELL,
Niagara Falls Power Company.

It does not make much difference what you do the first few years of your electrical career. Experience in life and the acquisition of methods of business are of more importance than your electrical training. After that it depends upon your bent, in what you would best succeed. Manufacturing is a good field; consulting engineering with reference to the equipment of power plants and factories is also good.

GANO S. DUNN.
Crocker-Wheeler Electric Company.

One branch of electrical engineering which will probably have the greatest development in the next few years is heavy railroad work, such as inter-urban and the application of electricity to the steam lines. There will probably be many opportunities for engineers of ability and prepared training in this line. In this branch of engineering, as in all others, practical experience will command better salaries than other kinds of training.

If you could get a position with some inter-urban road, where you could become familiar with details of such traffic, it would probably be the best preparation you could have.

MAURICE COSTER,
Westinghouse Electric and Manufacturing Company.

The answers to question 4 were a unanimous vote for the business end of it. This, of course, is looking at success from the pecuniary standpoint. The man in business has the best chance for making money. If happiness is our aim, however, and it gen-

erally is, that vocation pays the best which makes us the happiest. A man is unwise to continue in an occupation which he doesn't like, no matter how much money he is making. One of our correspondents expresses it this way: "I do not believe it makes very much difference as to which branch is selected by the ambitious young man. If I were a young man to-day I should probably select electrical engineering or some of its branches as my profession, irrespective of the question as to what the remuneration would be, because I believe that any business, trade or occupation, if you get to the front, will amply repay one's efforts. I should in the first place, carefully ascertain the necessary qualifications for that particular position. Those that I did not possess I would acquire at any cost, and after that I should feel perfectly serene as to the result. There is the whole thing in a nutshell, and do not forget that we cannot, as Goethe says, 'all be candles in this world, some of us must be candlesticks.'"

The best answer to question number 5 was as follows: "I believe a young man can become an electrical engineer without a college education, although it is the most valuable adjunct. Engineers are not made; they are born. Unless it is in a man it can never be developed. Ninety-nine people out of one hundred have to unlearn what they have learned in college; yet the experience is valuable to them, because they learned how to learn, which, after all, is the most valuable of all acquirements."

And in answer to question No. 6 the same writer says: "I think a college education pays if a man is going to be a journeyman or an oiler or a lamp trimmer, or just the man who holds the ladder while the other man does the work, for the reason given in my answer to question No. 5. That is because a college education teaches a man how to learn."

The point raised by question No. 8 is an open question. There is no doubt that influence is a potent force. It is the young man, however, who, by a happy faculty of making friends, secures his own influence that commands a higher respect than the young man who relies upon fortunate family connections. Employers agree that they want ability, not influence, and I know of a number of instances of successful electrical workers who secured their start with absolutely no influence. The young man who is pushing his own way will obtain a hearing if he has ability to sell, for every employer of labor in the city is just at present looking for more competent help.

Question No. 9 was answered as follows: "Some were naturally not fitted to the work or were too indolent; several were too visionary and did not direct their efforts towards particular ends. The greatest bar to success I have observed is the failure to study men and to cultivate an address."

Motor Regulation and Efficiency.

BY ALTON D. ADAMS.

The general efficiency of electric motors is high, ranging from about 78 per cent. in 1 horse-power to 90 per cent. in 25-hp sizes. There is, however, a method of speed regulation in common use with motors which reduces the combined operative efficiency to a very low figure, say to about 10 per cent. in case of a normal 5-hp motor operating at constant torque and at one-fourth speed.

It seems in the nature of a paradox that makers of electric motors after having with much care and expense produced machines which return about 90 per cent. of the energy put into them, as useful work, should then offer and sell these machines with regulating devices which reduce operative efficiency to the above low figures. Such, however, is the case, and the insistence for more economical regulation by purchasers is needed to cure the evil. Obviously it is of little value to the man who pays for watt-hours that his motor has a 90 per cent. efficiency at full speed, if his only method to obtain the various required speeds reduces the actual efficiency to one-half, one-fourth, or one-eighth of this amount.

The most desirable method of speed regulation for electric motors is evidently one which gives a maximum operative efficiency at all desired speeds, and as such a method is readily applied and is free to any who makes use of it, there seems no reason why users should not enjoy its benefits. This economical method of speed regulation would have come into general use long ago but for the fact that a motor arranged and proportioned for it costs somewhat more than one of the ordinary type, and users have not been aware of the difference.

As is well known, the common method of motor speed regulation is by means of a variable resistance in the armature circuit, which, in case of a motor loaded for a constant turning effort, consumes energy in nearly an inverse ratio as the speed of motor is reduced. For an example, take the case of a 5-hp motor, with resistance in armature circuit, drawing full current from the line and operating at one-fourth speed. Neglecting the armature resistance, which is small, the variable resistance, or regulator, consumes in the given case three-fourths of the energy from line, leaving but one-fourth to the motor: as the motor losses remain nearly constant with full current, whatever the speed, and as a 5-hp motor at full speed should have about 85 per cent. efficiency, or a loss in it of about 15 per cent. its full load, the net per cent. of line energy changed into mechanical work is about 1.00 — 0.75 — 0.15 = 0.10, or 10 per cent., which might be increased by 2 or 3 per cent. were correction made allowing for armature resistance. It may be fairly said that the above is an extreme case, but it is also true that efficiency many times that of 10 per cent. is desirable for average cases.

As methods of regulation are at hand which give practically a maximum efficiency at full load whatever the speed, one which involves a serious loss is not worthy of consideration, as the value of lost energy will amount to many times the first cost of motor during its life.

There are, as is well known, two methods by which to vary the speed of an electric motor without loss of efficiency; one is to change the number of wires in series with each other which cut the magnetic field, the other to vary the magnetic field by changing the exciting power or ampere turns on magnets. The usual and most practical plan for changing the number of armature wires in series is to place two independent windings on the armature and connect each to a separate commutator. This arrangement only permits speed to be varied by one-half the full rate at once, and is not, therefore, adapted for use in most cases, unless combined with some means by which intermediate speeds can be secured.

In the second method any intermediate speeds between the highest and lowest can be readily attained, and it is equally valuable to supplement the first method or when used alone. The field strength per ampere of series motors may be changed by a variation in winding connections, by disconnection of a part of the field coils, and by arrangement to short circuit or shunt some of the coils, either plan involving but slight expense.

In the more important case of shunt-wound motors any desired speed regulation above the minimum can be attained by a variable resistance in the shunt field coil circuit, the cost of this resistance being no more, if as much, as the usual speed regulator used in the armature circuit. This last method involves only enough loss in shunt field coil for full excitation at lowest speed, a constant loss in armature winding at constant load whatever the speed, and no external losses beyond these, so that a maximum efficiency for any given stage of load is maintained for all possible speeds.

The increased cost due to the equipment for variable field regulation results from the construction necessary to obtain sparkless commutation at high speeds and full load. The motor armature has its full reactive power at full load when the magnetic field available for reversal at commutation point is the weakest, so that the magnetic field, or, more correctly, magnetizing force expended in air gap at lowest speed is much greater than necessary for sparkless commutation. A longer air gap, larger field coil and longer magnet limb are made necessary by above requirements, and these combine to increase the cost of a motor of given capacity.

The saving effected by this variable field method of speed regulation in cost of operation is so great as to outweigh all differences of first cost, and regulation by resistance in armature circuit may be expected to shortly disappear.

A Decision Unfavorable to Electrical Auxiliaries on Warships.

The Naval Board of Bureau Chiefs of the United States is divided in its opinion as to the value of electric motors for auxiliary power upon warships. In the discussion upon the power to be used for the boat cranes, winches and some other auxiliaries for the five new battleships now being planned the Naval Board was unable to agree, and the decision was left to the Assistant Secretary of the Navy Department, who decided in favor of steam.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

Alternating Currents Twenty-five Years Ago and Today.

By EDWIN J. HOUSTON AND A. E. KENNELLY.

Twenty-five years ago, to wit, in 1874, alternating currents were few and far between. There were a few lighthouses fitted with electric arc lamps supplied by magneto alternators. These machines were principally of the Alliance type, giving a frequency of about 50 cycles per second. There were also small hand alternators in commercial use, for telegraphic signaling in place of batteries, and for therapeutical use.

EDWIN J. HOUSTON.

Although alternating-current dynamos were among the first machines to be applied commercially, yet they slowly gave place to direct-current machines, and this in spite of the fact that the direct-current machine is the more complex organization of the two. Several reasons were effective in bringing about the change. In the first place, magneto alternators were limited in their output, and dynamo alternators had to take their place in the natural course of development. But such dynamo alternators required continuous currents for the excitation of their field magnets, and an additional dynamo for supplying these direct currents was looked upon as an objectionable and unnecessary encumbrance. It was better to make a large single, self-exciting, continuous-current dynamo for all purposes than to make a small continuous-current dynamo to supply a large alternator. Another reason was the very imperfect theoretical knowledge existing at that time concerning alternating currents and their action. We know today how complex are the phenomena of such currents, and with the laws of behavior of continuous currents so imperfectly understood we can well imagine the distrust with which practical men regarded the alternator and all its works. Nevertheless, the present tendency of the electric art is a reversion toward the earlier type of alternator dynamo, and the elimination of the commutator, with a much more complex grasp of the technique of the subject, owing to the experience and research of the last five-and-twenty years.

The necessity for this return to the alternator was created by the expense involved in conductors for conveying electric currents to considerable distances. To reduce this expense, higher pressures became necessary, and it was difficult to make direct-current generators for pressures exceeding 5 kilovolts. The difficulty did not lie in the winding, but in the commutator. Moreover, it was just as difficult to employ direct-current motors as generators at such high pressures, and where a step-up or step-down transformer was required there the inevitable rotating commutator appeared also.

The alternating-current transformer stepped into the art to supply this end. While its capabilities were known long before 1874, having been established by Faraday, Varley and others, those capabilities were not generally appreciated or understood until Gaulard and Gibbs actually made alternating-current transformers of fairly large size and set them to work in 1882 and 1883. The efficiency of these transformers, poor as it would seem to the electrical engineers of today, was a complete surprise to most electricians, many of whom had come to consider alternating currents and alternating-current machinery as hopelessly wasteful. It became evident that alternating-current transformers were sufficiently efficient to be serviceable, and electricians turned their attention to the regulation of secondary pressure and current in these transformers, which was not at first all that could be wished.

Zipernowsky and Deri, in 1884-1885, were the first to install fairly large transformers operated in parallel from high-pressure mains. These were found to work with complete success, and since that time the alternating-current system of electric transmission has made rapid strides. At first the system was handicapped by the absence of alternating-current motors, but with the advent of the multiphase motor in 1888 this difficulty gave way, and now alternating-current motors are manufactured and installed to about the same extent as direct-current motors. The drawback of the alternating-current system has been the vis inertia, or hysteresis, or magnetic laziness of iron cores whereby work must be expended in maintaining a state of change in their magnetic condition, but transformers and their installation have been so far improved in recent years that the waste of power and money has been considerably reduced. It was long a matter of surprise to central-station managers how much coal was consumed in supplying a large number of transformers during the idle hours of the day or night, when the individual loss in each separate transformer appeared negligibly small. The modern tendency, where power is expensive, is therefore to employ transformers with as little core loss as possible, and to use large transformers to supply secondary mains on a block-facing rather than many small transformers, each supplying its own house.

The frequency of alternating currents employed has undergone considerable change. When first introduced in the United States the frequency was from 125 to 140 cycles per second. The reason for employing such relatively high frequencies was that the size and weight of the transformer was thereby reduced; since high frequency in alternating-current apparatus is the analogue of high speed in continuous-current apparatus, and it is well known that a high-speed, direct-current motor is smaller and lighter than a slow-speed machine of the same output. The advent of the alternating-current motor, however, changed the conditions, and at the present time scarcely any new alternating-current systems are installed with a frequency of 130 cycles. For general lighting and power work 60 is a much more common and useful frequency. It permits of good service with both arc and incandescent lamps, and it also permits of good construction in multiphase motors. Where transmission of power becomes the prominent feature, and where, consequently, the alternating-current motor is the principal device to be supplied, the frequency can, with advantage, be lowered. At 40 cycles the arc lamp can still be operated, and incandescent-lamp service is satisfactory. At 30 cycles the arc lamp is usually unworkable, and the limits of good incandescent lighting are reached. At 25 cycles the behavior of incandescent lamps depends upon their efficiency and upon the shape of the alternating-current wave. With flat-current waves, i. e., those approaching the rectangular contour, and with thick, low-efficiency lamp filaments, good incandescent lighting is possible, but with peaked waves of current and thin, high-efficiency lamp filaments, incandescent lighting is vsibly flickering in character, and disagreeable to the eye. The frequency of 25 cycles, which has now come into extensive use for the distribution of power, was first established in the Niagara Falls system by reason of the fact that the turbines there introduced had a rotary speed of 250 revolutions per minute, and that the designs for the alternators mounted on the turbine shafts gave best results with twelve field poles, corresponding to a frequency of 3000 alternations per minute, or 25 complete periods per second.

The long-distance transmission of power was not, however, won by the alternating-current system without considerable prejudice and opposition. The difficulties in the way were sufficiently great, but they were augmented by the diffidence due to the prevailing imperfect theoretical knowledge of the subject. It was predicted by some that the skin effect or spurious resistance due to imperfect penetration of the current from the surrounding dielectric medium into the conductor would prove a serious obstacle; that the inductance of the lines would be an insuperable difficulty, and that the losses of energy due to electrostatic capacity would be prohibitive. All these difficulties have been, however, for present purposes, overcome. The skin effect is usually too small to consider at ordinary frequencies. Thus, at frequencies of 60 cycles or less the additional spurious resistance of skin effect in the largest size of copper wire commonly used, namely, No. 000, is but a fraction of 1 per cent., and when yet heavier conductors are required it is desirable to subdivide and strand them, if only for convenience in handling and stringing. The same is true for wires of aluminum, which are already being used as long-distance electric conductors. The skin effect in a round wire is a function of the frequency, and of the resistance per unit length. If the frequency is constant, and if the resistance of the wire per unit length is the same, the additional or spurious resistance due to skin effect remains unchanged. Consequently, if the spurious resistance due to skin effect in a certain copper wire is, say, one-fourth of 1 per cent., then the aluminum wire, which is equivalent in conduction to this copper wire, will also have a skin effect of one-fourth of 1 per cent. Since the conductivity of good hard-drawn commercial aluminum wire to-day is 60 per cent. of Matthiesen's standard of conductivity for soft copper, or about 61.2 per cent. of good hard-drawn copper, an aluminum wire must have about 62.6 per cent. more cross-section, or about 27.5 per cent. more diameter (with approximately half the weight) to be the equivalent in resistance to a copper wire of any given

size, and the extra resistance due to skin effect in the correspondingly enlarged aluminum wire will be the same as in the equivalent copper wire.

As regards the self-inductive effect of long-distance transmission conductors, the consequences have not been so serious as many were at first inclined to predict. The impedance effect of a pair of large parallel copper wires (000 A. W. G.) at an intervening distance of a foot, and with a frequency of 40 cycles, is about 1.43, representing an impedance of about 43 per cent. in excess of the ohmic resistance, but by no means all the extra apparent resistance produces drop of pressure in the conductors, and none of it causes waste of energy. Moreover, the effect can be reduced as greatly as desired by subdividing the conductors. The self-inductive effect has not, as yet, proved a serious difficulty. Moreover, it has been found that impedance in the lines leading to the rotary converter actually improves the regulation and behavior of that apparatus.

Evolution in alternating currents has also extended to the type of e. m. f. wave generated by the alternator. It is known that peaked waves tend to reduce, to a slight extent, core losses in transformers, while smooth sinusoidal waves are preferable for long-distance power transmission. The wave form of e. m. f. can be predicted from the design of a new generator with all desirable accuracy, although the modifications in the wave form which are produced by the reaction of the current in the armature, under load, are not so easy to predetermine.

A type of alternator for long-distance transmission which is rapidly coming into favor is that in which the armature is stationary. This type of machine is found in the "revolving field alternator," in which the field-magnet frame rotates within the stationary encircling armature, and also in the inductor alternator in which a mass of iron is revolved and no conductors rotate. Machines of these classes are built to give pressures of 10 kilovolts at their terminals, under load. This affords an extended commercial radius of transmission without the necessity of introducing a step-up transformer between the alternator and the transmission lines.

For still greater distances, step-up transformers are introduced reaching pressures up to 40 kilovolts in commercial use. The full working advantage of 40 kilovolts has not, however, yet been secured, and such a pressure is still very rare. The higher the pressure the greater is the difficulty in protecting the system from lightning and from occasional break-downs due to accidental short-circuits. Moreover, it is found that at and above such pressures there commences to be a new loss of power along the transmission lines, due to convective electric discharge. When this convective discharge is powerful, the wires emit a phosphorescent glow that is visible at night. It may be expected, however, that further study and research will indicate means for obviating or minimizing this difficulty, and meanwhile much remains to be accomplished before the full commercial range due to 40 kilovolts can be availed of. The radius of commercial transmission at such a pressure should be at least 100 miles.

In addition to the use of alternating currents for the transmission of electric power at the present time, alternating currents are also employed in electric telephony and in electric signalling, and the properties of alternating currents would have to be studied for the adequate prosecution of electric engineering in those branches. The range of frequency in the alternating currents used for these purposes is far greater than in the electric transmission of power, and we may, consequently, expect a more rapid and extensive development of knowledge and of application in these directions. It is only reasonable to expect that when the means have been developed for producing and controlling high-pressure alternations in the ether that the processes will be utilized in directions that are not yet recognized.

An Illustration of the Spread of Electrical Knowledge.

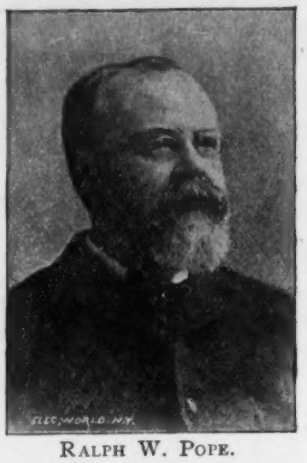
BY ALEXANDER MACFARLANE.

The volt, ohm and ampere were defined by the first International Electrical Congress, which met at Paris in 1881. Soon after a joke appeared in the funny columns of the newspapers. "It is said that an ampere is equal to a volt divided by an ohm; we do not see how it could be otherwise." Then the words conveyed no idea even to intelligent people; now the aldermen of any country town talk familiarly of volts and amperes.

The Rise of the Stock Reporting Telegraph.

BY RALPH W. POPE.

Those applications of electricity which are most generally known to the public are naturally the most important, and within the lines of the profession there are now but four grand divisions, the telegraph, the telephone, the electric light and power transmission. Twenty-five years ago the telegraph had already entered upon an era of sub-division, and the fire-alarm, firmly established, had been followed by the gold indicator, the stock reporting and the district telegraph systems. Soon after the beginning of the Civil War the premium on gold became a most important factor in commercial transactions, and by its fluctuations all other prices were influenced. After its establishment, the "Gold Room," located near the present Stock Exchange, was the very heart of speculation on the "Street." But one commodity was dealt in, and that was gold. To display its varying prices something more active and reliable was required than the combination of a blackboard, a piece of chalk and a boy. Dr. S. S. Laws, then an active officer in the Gold Room, appreciated the want, and invented what became known as the "gold indicator." As first introduced, it was intended merely to exhibit in the room the prevailing price of gold. It was placed on the west wall, where it could readily be seen, and was driven by electricity, controlled by two circuit-closing keys, operated by Mr. Mesereau, who was the official registrar of the board. I presume that the claim of the inventor was the peculiar escapement used, by which the fraction drum of the indicator could be driven in either direction, technically known as the advance and retrograde movements. The "fractions" drum, divided into "eighths," geared into the "units" drum, while that in its turn was geared into the "tens" drum, one revolution of each driving the next higher a single figure, in the well-known manner made familiar to-day in speed indicators and cyclometers. There being but a single indicator on the circuit, little care was necessary on the part of the operator, as, in case the fraction drum was driven too far, it could be readily brought to its proper position by using the reverse key. Four pulsations were required to move the drum the distance between the fractions. From this device for showing the price of gold on a single indicator a system was evolved for displaying simultaneously the quotations in any required number of brokers' offices. It was obvious, however, that a number of indicators, unseen by the operator, could not be accurately manipulated in the rather erratic manner peculiar to the unskilled hand of Mr. Mesereau. I do not know whether Dr Laws had in view a system of gold indicators when he placed the single machine in the Gold Room, or whether the success of the latter suggested the possibility of a number of similar instruments operated from a central station. A lot of so-called "dial" indicators were manufactured at the establishment of C. T. and J. N. Chester, and when this equipment was ready for installation the late Franklin L. Pope was recommended to Dr. Laws as a competent man to undertake the work, and he was subsequently superintendent. The instruments made for this purpose were similar to the Gold Room indicator, but, instead of the figures being painted on drums, metal dials were used, overlapping each other. They were also smaller, and in the case beneath the mechanism a suitable space was reserved for a battery, as it was the intention to use relays at each indicator, which was thus placed in a local circuit. The central office was located over the Gold Room. In order to avoid the uncertainty of operation arising from faulty contacts, two automatic transmitters, one "advance," the other "retrograde," were installed. These were driven by weights, and the speed was quite slow. The mechanism was released by an electrical device under control of the registrar, and each change of a quotation was shown by permitting the transmitter to make four continuous pulsations. An indicator in this system was placed on the front of the gallery in the Gold Room, so that the registrar could watch its movements. In practice the official indicator was first moved, followed immediately by a similar change on the distributing system. Among the



Ralph W. Pope.

improvements introduced by the superintendent was the abolition of the local battery at each indicator, and the use of metallic circuits. A new form of indicator was also devised, known as the "small drum," which was found much more satisfactory than the dial form, and neater in appearance as no battery space was required. This pattern continued in use until the restoration of specie payments terminated the career of the gold indicator in 1879.

The financial success of the enterprise led to the establishment of a system for the distribution of stock quotations. This undertaking was more complicated, however, for in this case there was a constantly increasing list of stocks and bonds with fluctuating prices. About 1867 Mr. E. A. Calahan, a printing telegraph operator, appeared on the scene with his "three-wire stock printer," It was a simple affair, and originally crude in its construction. It was slow in operation, but at that time it seemed well adapted for the service to be performed. It had two type-wheels, one for letters and punctuation marks, the other for figures and fractions, there being two complete sets of the latter, making thirty characters on each wheel. Each type-wheel was driven by a forward escapement, the lever being operated by an electro-magnet. A separate wire being required for each type-wheel and another to operate the press lever, each route required three wires. At the outset these stock printers were equipped with relays and local batteries, but following the practice of the gold indicator management they were subsequently placed on the main circuits, and the local batteries dispensed with.

The instruments were operated by a hand transmitter in the central office, which was located at 18 New Street. This consisted of two dials, one each for the letter and figure wires, and driven by two separate cranks and suitable gearing. A simple "make and break" lever, with platinum contact points, was operated by a ratchet wheel in the centre of each dial. The press wire was operated by an ordinary Morse key. As each type wheel was brought to its proper position, a pulsation produced by pressing the Morse key threw the press lever against the type. The stock instruments were not worked directly from the transmitter, but the latter was in a local circuit leading to the relay case. Three relays were, of course, necessary for each route, which was made up of three wires. In the service these three wires were known as a "circuit," although, properly speaking, they formed three circuits. In practice not over twenty-five instruments were located on a circuit, and as the number of instruments increased new circuits were established, or the old ones divided. The stock quotations were transmitted from the floor of the Stock Exchange by the Morse system, and received by sound, the receiving operator sitting by the side of the stock transmitting operator in the central office.

Shortly after the introduction of the Calahan printer, gold, as well as stock, quotations were sent over it. This practice was not as satisfactory to subscribers as the gold indicator, as the latter displayed at all times the prevailing gold quotations. Whether Dr. Laws considered it an interference with his business or whether it had been his intention to embark in stock reporting at the proper time is not known to the writer. The gold indicator system having been practically perfected, and earning a good revenue, Dr. Laws prepared to introduce his stock printer. A lot of instruments were manufactured, and preparations made for their installation. Three wires were also required for his printer. As he used the "advance" and "retrograde" escapement like that which was so satisfactory for the gold indicator, one wire was required for each movement, the third being used for the press lever, as in the Calahan printer. Instead of a crank transmitter, however, the pulsations were made by ordinary Morse keys, as it was thought a skilled operator could handle them with sufficient steadiness. A "unison" was also introduced, so that the operator could occasionally bring all instruments into synchronism to rectify any "throw-outs" that might occur. It was the intention to receive quotations by the Morse telegraph from the Stock Exchange, but Dr. Laws evidently thought that such a plan could be improved upon. I had been engaged for the work of receiving the quotations by sound, and was waiting for the moment to arrive when my allotted duty would begin. Suddenly Dr. Laws determined that a tin speaking tube was a more satisfactory device than a telegraph wire, and I foresaw that my occupation was gone. I believe that three lines of tubing were erected, one to the Stock Exchange, another to the Government room, and the third to the Open Board of Brokers. Compared with the Morse telegraph, the speaking tube was a failure. Walter Moss, gifted with unusual lung power, would howl out W-e-s-t-e-r-n U-n-i-o-n T-e-l-e-g-r-a-p-h C-o-m-p-a-n-y with great success, but when he came to the figures there was an occasional shadow of doubt as to the exact price named. No argument could prevail against the admitted simplicity of the speaking tube, but my belief that it had no future was strengthened by the fact that the Morse telegraph, as used by the Gold and Stock Company, eventually prevailed as the survivor of the fittest. I was not immediately thrown down, however, for considerable construction work was going on, and I was transferred to the "gang." I appreciated the fact that this was but a temporary assignment, as I was drawing the pay of a skilled operator, and doing the work of an unskilled lineman. My notice came in the middle of the week, and the following Monday I entered the employ of the Bankers' and Brokers' Telegraph Company, and was given a "day trick" in the Gold Room office of that company, under Manager John D. Stough. Here I was incidentally brought into the field of conflict between Dr. Laws' Gold and Stock Reporting Telegraph and the Gold and Stock Telegraph Company. It appeared that the latter was being supplied with gold quotations over a Morse wire by Mr. Stough, who received a small stipend for the service. As nothing but a counter separated him from the brokers in the Gold Room, he could watch the local indicator for the change in price, or even anticipate it by carefully watching the market. I had noticed, however, that he usually waited for the indicator to complete its movements, and sometimes, when busy elsewhere, delayed sending a new price. The speaking tube episode being fresh in my mind, it occurred to me that I might facilitate the transmission of gold quotations, so I began at once to assist Mr. Stough in his work. So alert did I become in this assumed duty that, by watching the market, I sent in the change of price before the distributing indicators were started; so that the Calahan stock printer was frequently ahead. Curiously enough, at just this time the superintendent of the Gold and Stock Telegraph Company had been censuring the receiving operator, Henry Van Hoevenbergh, for his delay in handling the gold quotations. He had fruitlessly endeavored to prove that it was not his fault, and it was assumed that Mr. Stough was using due diligence. It was at this juncture that I appeared upon the scene, and there was no further complaint of delay. While I was engaged in this service the celebrated "Black Friday" panic occurred. The gold indicator system, which was based on a movement of four pulsations for each fluctuation of one point, was not equal to a sudden jump of 12 or more points. The continuous running of the transmitter in the frantic endeavor of Mr. Mesereau to keep up with the market had led to the heating of a platinum-pointed spring, the melting of solder and the consequent demoralization of the system. This was the juncture at which Mr. Edison appeared on the scene, and located the trouble. Although I was not present, I can readily imagine that Dr. Laws lost his head under the above conditions, and that in his nagging of the superintendent the latter was also rattled. Mr. Edison was a free agent, and being familiar with the system had no difficulty in detecting the cause of the trouble. I make this explanation for the reason that it should never have been intimated that Mr. Pope was not capable of ferreting out a defect of this kind. As is usually the case, the rivalry between the two concerns eventually resulted in consolidation, Dr. Laws' enterprise being absorbed by the Gold and Stock Telegraph Company, while the Laws stock printer was relegated to the scrap heap and the museum. Competition in the field did not, however, cease. Messrs. Pope and Edison invented a one-wire printer, and started a system of "gold printers" devoted to the recording of gold quotations and sterling exchange only. It was intended more especially for importers and exchange brokers, and was furnished at a lower price than the indicator service. The late J. N. Ashley was a partner in this enterprise, and the building and equipment of private telegraph lines was also entered upon. This business was also subsequently absorbed by the Gold and Stock Telegraph Company, which was probably at this time at the height of its prosperity. The financial organization of the company was peculiar and worthy of attention. Each subscriber for a machine paid in $100 for the privilege of securing an instrument. For the service he paid $25 monthly. In case he retired or failed, he could transfer his "right," and employees were constantly on the alert for purchasable rights which could be disposed of at a profit. It was occasionally worth the profit to convince a man that he did not actually own the machine which had been placed in his office. In the course of three or four years the company outgrew its quarters at 18 New Street, and moved its offices to 61 Broadway. The Western Union Telegraph Company secured a majority of its stock, and General Marshall Lefferts was elected president. A private line department was established, and

the business taken over from Pope, Edison and Ashley was rapidly enlarged.

The Calahan three-wire stock printer still held its own in the great down-town district, about 800 machines being then in use. The "Universal" printer, invented by Mr. Edison, had also been introduced to a limited extent. It was used on the Cotton and Produce systems, also on the uptown stock circuits. The letters and figures were arranged as in the Calahan printer, but, instead of having independent type-wheels, the two lines of characters were cut on the periphery of a single wheel, secured to a sleeve. An ingenious shifting device was so arranged that by bringing the type wheel to a certain point, a blow from the press lever would shift the type-wheel, so that either letters or figures could be printed at the will of the transmitting operator. This machine was driven by the so-called star ratchet. These instruments were supposed to have been made with interchangeable parts, but as a matter of fact the instances in which these parts would fit were very few. The instruction book, prepared for the use of inspectors, stated that, "The parts should not be tinkered nor bent, as they are accurately made and interchangeable." The difficulties encountered in fitting them properly, doubtless gave rise to a story that Mr. Edison had stated that there were three degrees of interchangeability. This was interpreted to mean: 1st, the parts will fit; 2d, they will almost fit; 3d, they do not fit, and can't be made to fit.

About 1200 of these "Universal" printers were made, most of them being placed in service in different parts of the country. These machines were simple and substantial, and were generally satisfactory.

In 1873 the Manhattan Quotation Company entered the field as a competitor with an instrument driven by a weight, and governed by an escapement. It proved to be faster than either the Calahan or Edison printer. The former had been improved somewhat in construction, but the principle remained the same. It was very important that some radical change should be made, as serious inroads were being made upon the income of the company. The late George M. Phelps, Sr., about this time perfected a beautiful instrument for this service, and a pair of them was set up as an example of what the company proposed to do. Nothing came of this, so far as stock quotations were concerned, but a lot were made and used on the Cotton and Produce systems.

In order to meet the competition of the Manhattan Company, the Calahan printers were remodeled, and the star escapement introduced similar to that used on the Edison printer, excepting that the wheel was moved one step on the up stroke as well as the down stroke of the escapement. By this device the speed was doubled. The instruments were also equipped with a very ingenious automatic unison, invented by Henry Van Hoevenbergh, which, however, was adapted only to the Calahan printer, which had two independent type-wheels. It was so constructed that if either type-wheel fell out of synchronism a latching device locked it to the adjacent wheel, which carried it to unison. A beveled lifting device prevented the latch from locking the wheels when at the point of unison. The rental of instruments was also reduced to $10 per month, and competition went on merrily, resulting finally in the absorption of the Manhattan by the Gold and Stock Telegraph Company. This movement did not lead, however, to permanent peace, for subsequently this attractive field was invaded by other opposition companies, notably the Commercial Telegram Company, using an instrument invented by Stephen D. Field, and the Stock Quotation Company, with the Wirsching machine. The Gold and Stock Company again met the emergency by equipping its lines with a printer invented by its superintendent, Mr. George B. Scott. Although capable of a speed of 170 revolutions per minute, it has been taxed to its utmost to keep pace with the volume of business recently transacted in the Stock Exchange, in which for many days the sales have passed the million mark, the highest record being 1,610,000 shares, which was reached on Monday, January 13, 1899.

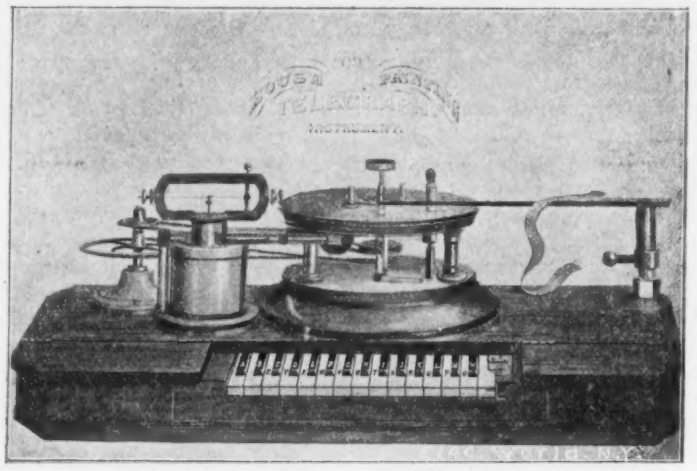
Professor Pacinotti.

It may not be generally known that Professor Pacinotti, the inventor of the toothed armature, is still living, and is by no means an old man. According to the London "Electrician," he is professor of physics at Pisa, but is not devoting much attention to electrical subjects. His famous dynamo of 1864 was exhibited at the recent exhibition at Turin, and besides this there were shown discs and drum armatures which antedate those of Siemens.

Some Reminiscences of the House Printing Telegraph.

BY J. E. SELDEN.

Probably not one in a thousand of the present readers of The Electrical World ever saw or heard of the House printing telegraph, which was long ago permitted to sink into oblivion, to the serious loss (in my opinion) of the general public, as in the matter of freedom from liability to error in the transmission of dispatches it was greatly the superior of the Morse system, now almost universally in use. I mistrust my ability to give the general reader anything more than a crude idea of the working of this necessarily somewhat complicated machine, but may be partially assisted by the cut which it is intended shall accompany this article if the engraver finds it possible to revive the lines of a faded old photograph of the instrument, which I have preserved as a memento of the old times. With apologies for my ignorance of the correct mechanical terms required, I will commence at the large end, which usually consisted of a jolly Irishman, whose function was to turn the wheel which furnished the motive power for the various parts of the machine (also worked a condensing air pump), and who was called "the grinder." He was a very useful and important part of the machinery. The condensed air was forced through a pipe to a valve chamber, when, by the action of the valve, it was thrown alternately on to the ends of a "plunger" as it was called, which, vibrating horizontally in an air-tight chamber, controlled the movement of an es-



The House Printing Telegraph.

capement similar to that in a clock, which in turn controlled the movements of the type-wheel, allowing one letter to pass at each vibration. The valve which governed this air pressure was attached to the steam of what was called an "axial magnet," which consisted of a series of soft iron buttons suspended vertically in a helix of fine wire, its vibrations being caused and controlled by the breaking and closing of the circuit, which was done by a wheel of fourteen cogs and the corresponding spaces and a spring, which, touching the face of each cog as the wheel revolved, caused very rapid vibrations of the magnet. The wheel was controlled by the keyboard, each key bearing a pin, which, when depressed, engaged with a corresponding pin on the sleeve of the cog-wheel and held it in position until the printing of the letter in front at the time was accomplished by a mechanism which I will not attempt to describe. I have been reminded while attempting this feeble description of a much simpler one which was attributed to "Covell," the operator at Troy, who, when called upon to explain the working of the instrument to visitors, would take hold of the top of the valve-stem (heretofore described) and, giving it a shake, would say: "You see this little jigger that moves up and down? Well, that's what does it!" And I presume this explanation was fully as satisfactory as mine will be!

My induction into the art télégraphique occurred in the Reynolds Arcade, Rochester, N. Y., in the fall of '49, when, under the coaching of Starr Hoyt, I soon rose to eminence (in my own estimation), and in the early spring was detailed to open an office at Dunkirk. After a tedious delay of a week or so, which seemed like eternity to me, the instrument arrived and I unpacked and set it up, confident of my ability to "astonish the natives," of whom a goodly number had assembled to view the new contrivance. For economy the "grinder" had been omitted in this case, and the motor consisted of a treadle worked by the operator. I hitched on and commenced

to kick. The instrument commenced to "kick" at the same time, producing a series of rhythmical squeals like a dying rat (which were taken up and re-echoed by the crowd of "gamins" in the room) and nothing else!

My face has always had a trick of advertising the fact of my having taken a glass or two of beer by a becoming blush. On this occasion it must have indicated that I had swallowed a whole brewery. I was wild, and to "pile on the agony" it happened that "Uncle" Isaac R. Elwood, the secretary and treasurer of the company, had selected that day to make a friendly call, and was a quiet but amused witness of my sufferings. I got my wits after a time, and when "reason regained her throne" it occurred to me that the lack of air-pressure and the whistle could only be due to the absence of some necessary valve in the air pump. The rest was easy. A sharp knife and a requisition on my boot leg (everybody wore boots then) furnished the "missing link," and I was soon distributing printed slips of the latest intelligence among the audience; but it was a "mauvais quart d'heure," as the French say.

One other little incident which occurred during my stay at Dunkirk is still fresh in my memory. It was a warm afternoon in June, and a shower came up. The lightning used to make havoc with the fine wire of our magnets, and as a matter of prevention I "cut out" (i. e., disconnected the line wires from the instrument). The shower soon passed over, and feeling lonesome without the "purr" of the magnet, I connected up again, but found the circuit open. The next thing was to test to see on which side of me the "break" was. Most telegraphers know how this is done. I got current from the battery at Cleveland all right, and had the Eastern wire and "ground" wire in my fingers, when I was surprised and greatly shocked by the arrival of about three-fourths of a pound (weight estimated!) of very healthy lightning, which made free use of my corporeal system as conductor to reach the ground, and doubled me up like a jackknife. It immediately dawned upon my intellect without a suggestion from anybody that the shower was still actively engaged in business somewhere to the eastward, and from that day to this I have studiously avoided handling telegraph wires immediately after a shower, and have rigorously abstained from killing two or three people who needed it, rather than subject myself to a repetition of a similar experience in the "electric chair."

In the old times of which I am speaking an operator was expected to look after the repairs of the line half way to the next station on either side of him, and a "break" or a "cross" of the wires was a signal for a rush to the nearest livery stable and a call for the best turnout the establishment could furnish. Bills for "expenses" were paid without a murmur, and they sometimes covered some items that would have to struggle to get through the bookkeeping department of the "Postal" at the present day. I have often thought I would like to see one of our lady operators on top of a 30-foot pole with a pair of the three-pronged climbers in use then strapped to her propellers, trying to reach a break. She would cut a figure, if she didn't cut anything else.

When the line followed a railroad track, a pair of pliers and a coil of wire was the only "pass" needed to ride the whole length of the road on any train, and there used to be wonderful tales told of repairs that were made under the most adverse circumstances. "Stager," who later became general superintendent of the Western Union, was credited with having once (when he was short of wire enough to repair a break) spliced in 4 feet of grapevine and worked the line successfully through it until the sap died out. But I never believed the yarn.

From Dunkirk I drifted to Erie, to Cleveland, to Buffalo, and thence to New York, where the headquarters of the printing system were at 21 Wall Street, corner of Broad, in a sort of chimney of a building luckily only five stories high, and which, while excavation was being made for an adjoining building, got a "list to port," as the sailors say, so pronounced that a man was stationed for days on the opposite corner to watch and give the alarm if she lost too much of her perpendicular. "John Horner" was receiving clerk and general financial manager. In the former capacity he was a "peach." The calm assurance with which he would look a customer in the eye and tell him he might confidently expect an answer from Cincinnati or Louisville in a very few minutes, when it was a moral certainty that the message would go to Albany by express that afternoon at 5, was something beautiful to see! A broker rushed in one morning waving a disreputable-looking $2 "queer" and sternly demanded, "What do you mean by sending this thing to me in change?" "Well! I declare," replied John, without the slightest agitation or variation in his cast-iron smile, "this is the third time that old rag has come back this morning," and passed it over to me with, "Here, Jack, take it and play it in somewhere to-night." That was more "gall" than the broker could "stack up against," and he walked away with another good bill and a smile as wide as his face. John Horner was smooth. Another customer from the West, who persistently demanded the answer he had been promised and waited all day for, was sent up to the operating room, while a note reached me via "the dummy" to show him the "instrument" and amuse him if possible until "Horner" had a chance to get away. It was getting toward night, and a little dark, so I lit the gas, as we were in the habit of doing, by touching the jet with the end of one of the battery wires. This proceeding was evidently a novelty to the "come on" and attracted his attention. After printing off some "specimens" for him, which he eagerly bagged, he asked if he could get a short piece of that kind of wire we lit the gas with, as he should like to take it home and show his boys the operation. He was immediately furnished with a piece of the insulated office wire, which he carefully wrapped up and deposited in his wallet; but whether the experiment was successful when he reached home I have never heard.

The printing system of telegraphy will come back some day, and come to stay. The introduction of the typewriter in receiving was a great improvement, but the system is still subject to the liability to error inherent in the Morse alphabet. The instrument of the future will be some combination of the typewriter with the transmitting and receiving apparatus (or something similar) of the old "House" machine, with the objectionable tape of dispatches eliminated. Indeed, I hear that the Western Union already has a machine of this kind, though I have never seen it. But this article is "up to the limit" in length, if not in interest, and I must reserve other reminiscences for a future number.

Twenty-five Years.

BY THOMAS HENNING.

Looking forward, this period of time appears as if almost without an end. Looking backward, it appears to be but a month, as it were. Can it be possible that, since the establishment of your very valuable and widely read paper, grave doubts have been expressed as to the success of the telephone, trolley car, etc.?

"'Tis true, 'tis pity,
Pity 'tis, 'tis true!"

Railroading, lighting and telephoning have made wonderful strides. Compared with these (strange to say) our dear old friend, telegraphy, appears to have been left "at the post," as it were. Of course, the substitution of the dynamo for the battery in telegraphy was a great improvement, but the quadruplex, as a means of communication, appears to hold its own and the "quad" is "of age," to say the least.

The storage battery, which doubtless will shortly be an auxiliary in almost all branches of business, is another of the products of the past few years which cannot be overlooked. Of course, I refer to the battery in its present commercially successful shape.

Commercially, I believe that the greatest advance has been made in railway work. When one thinks of the capital invested and of the number of miles of track operated electrically, compared with the length of time that the electric railway has been in existence, I believe that my claim is not extravagant.

The distribution of electrical energy, having the Falls of Niagara as a source, cannot very well be overlooked. At the time that THE ELECTRICAL WORLD was established even the able men connected with it at that time could hardly have given credence to these visions: In the city of Buffalo, streets lighted by energy generated 22 miles distant, cars in the streets being moved by the same power and workshops of different kinds using it exclusively.

In this connection permit me to call the attention of your readers to the fact that the man who first made use (in the city of Buffalo) of power generated at Niagara Falls was also the pioneer in predicting the use of electricity for the purpose of replacing the "dear old horse" on our street-railway systems. I refer to Mr. H. H. Littell, vice-president and general manager of the Buffalo Railway Company, who, as president of the American Street Railway Association (assembled in convention in Chicago, Ill., in October, 1883), in the course of his address used these words:

"The sciences, each with its demonstrated truths and wonderful appliances, that can even calculate the time required to think and

the time required to carry thought into action, or the difference, estimated by the fractional part of a second, between thinking and volition, have swept humanity forward in its course, until the steam engine, the ocean steamer, the telegraph and the telephone have ceased to be classed as wonders; and we face the last and greatest discovery of the century, the application of which bears more directly upon our immediate interests than any other, namely, electricity as a motive power. So long as purely brute strength and endurance enter so largely as a factor in our enterprise there must ever be perplexing and annoying obstacles that the ingenuity of man will be taxed to overcome. Any invention looking toward the abolition of these, thus simplifying our methods of locomotion, will be eagerly welcomed and thoroughly discussed in our deliberative councils. I see in the recent subjugation of the subtle and hitherto illusive force of electricity to the needs of man, boundless possibilities for the world's great requisites for advancement—heat, light and motion.

"The crude experiments already made with electricity as a motive power in propelling cars, in lieu of steam or horse-power, clearly foreshadow the inevitable application of the new motor to our immediate interests."

Edison's Aspirations to Become a Joss.

BY F. H. JOHNSON.

As illustrating Edison's happy sense of humor and its indulgence even under conditions not particularly conducive thereto, the following anecdote may be interesting:

He and I were engaged in the early seventies in our usual night-work of experimenting in telegraphy; our laboratory for the time being was on the top floor of the old gray stone building, No. 66 Broadway, the present site of the magnificent Manhattan Life "sky-scraper." Neither of us was much given to pecuniary forethought, and it not infrequently happened that along about daylight, when weariness and hunger combined to paralyze our mentality and render further work useless, we would find ourselves without so much as a nickel wherewith to purchase a bun, not to speak of a bed; and upon such occasion we would combat the weariness and the hunger by a brisk walk to Central Park and back, by which time the office boy at least would be on hand and ready to assist us to a meagre but grateful breakfast at Coffee Pat's, a well-known penny-lunch establishment on Park Row, whose sole other patrons were the "printers' devils" of the various newspapers in that vicinity.

E. H. Johnson.

It was upon the occasion of one of these gray morning saunters, when we were particularly hungry, having had rather more of physical than mental labor that night, and in consequence looking very much begrimed, that Edison remarked as we were passing the inviting Pat's: "Say, Johnson, we had better quit inventing and hire ourselves out as a pair of Chinese gods. We would be a more brilliant success. At least, we needn't go hungry."

The First Incandescent Lamps in Multiple.

BY F. R. UPTON.

In the history of electrical progress I assisted at one event of first magnitude—that is, the creation of the Edison system of electric lighting.

In Menlo Park, in 1879, I remember lighting the second high-resistance carbon incandescent light in multiple arc with the first, both run from an armature of low internal resistance. There was no flicker to be seen in the first when the second was thrown on and off the circuit. Calculation had shown that there should be none, and this trial proved that the theory was correct.

The first house lighted in Menlo Park was the one opposite the railway station on the path toward the laboratory. The first dinner party by electric lights was given in this house. Lamps were hung in the corner of the parlor of the house close to the ceiling. Mr. Grosvenor P. Lowrey, of charming memory, suggested this method of lighting, now so common. Ten years from now my anec-dotage may be more pronounced; this should be enough for the present.

Some Recollections of Twenty-five Years of Wire Making.

BY EUGENE F. PHILLIPS.

I have my books of 1874 before me, and it makes a reminder that from my commencement in business in 1870 to this date I was my own president, vice-president, treasurer, secretary, bookkeeper and superintendent. I find the sales of the year 1874 were $24,856.60, and include such old-time customers as Charles Williams, of Boston; F. L. Pope & Co., of New York; L. G. Tillotson & Co., New York; E. Holmes, afterward Holmes Burglar Alarm, New York; Seth W. Fuller, Boston; Charles T. Chester, New York; Thomas Hall, Boston; A. G. Davis, afterward Davis & Watts, Baltimore, and the Gold & Stock Telegraph Company and the American District Telegraph Company, of New York, and other old-timers. Some of these names will only be remembered by men who have been long in the business.

Eugene F. Phillips.

I believe I made the first braided wire used for outside purposes of any one in the country, for the parent American District Telegraph Company, of New York, and others. If I had an order for 500 or 1000 pounds at a time, I thought it was immense. The prices for braided office wire at that time were also interesting. I see No. 13 waterproof wire at 80 cents; No. 19, same quality, $1 per pound. For this same quality of wire to-day we are pleased if we get an order netting us 25 cents per pound, and there is no such marked difference between the different sizes of wires. Other prices are also interesting. For No. 12 braided iron telegraph wide we would get from $100 to $125 per mile; silk cord 5 cents per foot; No. 19 magnet wire, for instance, 80 cents per pound, and No. 14 rubber-covered wire, 5 cents per foot. Business was good, however, in the limited way, and the majority of letters would be to hurry up orders.

We had not the thorns in our side at that time represented by the Washburn & Moen Manufacturing Company, John A. Roebling's Sons Company, Holmes, Booth & Haydens, and others, who had not yet turned their longing eyes to insulating electric wire. About the only people I would run up against would be the Western Electric Manufacturing Company, of Chicago, and Joseph Moore, of Philadelphia, father of Alfred F. Moore, who made principally magnet wire, cords, etc., and what was at that time called a bonnet wire, made with a longitudinal strand held in place by one wrap. I am not just sure when he began to make braided office wire, but I know I did not see much, if any, in the market up to about this time. There was also the Bishop gutta percha wire, and Day's Kerite wire, which covered about the only insulated wires I would see.

The articles manufactured were few in variety, consisting principally of magnet wire, silk and cotton covered for call-bell, and telegraph relay magnets; finer sizes, such as 36 and 38 B. & S. gauge wire, were regarded as a curiosity more than of actual use. At the present time 38 and 40 are used in large quantities, and sizes 0.002 and 0.0015 are used to some extent in connection with medical coils and test instruments.

The telephone had not as yet made its appearance, and telephone cords, which are now made in the thousands, were not enumerated in the price lists. Braided office wire was used only to a small extent until the advent of the Gold & Stock Repeating Telegraph Company and the American District Telegraph Company. The establishment of stock-repeating instruments, which at that time required three circuits, made quite a demand for office wire, and the connection of hundreds of messenger call boxes in residences and stores throughout New York and other large cities, with numerous central offices, caused a still greater demand for the same article. With this cables were used to some extent, but usually the prevailing custom was that of running a large number of wires through cleats upon the wall, or in a box or trough under the floor.

Underground cables were almost unknown. Submarine cables were used in short lengths for river crossings, being insulated with gutta percha, and made by the Bishop Gutta Percha Company. The rapid development of the telephone business of the country after 1876 gave an impetus to the manufacture of insulated wire of all descriptions, both wound and paraffined. Annunciator wire, which had heretofore been used particularly for call-bell work, was a very convenient article in the installation of a telephone set, and the demand increased accordingly. Telephone cords, which were at first called for by the dozen or twenty-five, were soon ordered in lots of a hundred, and later shipments were made which necessitated the use of a barrel, which served as a convenient receptacle for packing them. The natural increase in the number of aerial wires created a demand for better insulation and grouping in cables. Hundreds of miles of No. 12 iron wire were braided and dipped in suitable compound for this use. The annoyance from induction soon made a call for anti-induction cable. This want was supplied by a tinfoil cable so called, in which each conductor, after being insulated, was enclosed in a strip of this tinfoil. Cotton-covered wires to the extent of 50 or 100 were cabled together, and after being saturated with paraffine were placed in a lead pipe. This style of aerial cable, although quite satisfactory, has to a great extent been replaced by the paper insulation undergound cable of the present day.

In 1882 the American Bell Telephone Company, wishing to make some practical experiments on telephonic transmission with underground wires, ordered of us a cable to be 5 miles in length, containing twenty-one wires of No. 20 B. & S. gauge, a majority of which were to be insulated with rubber and the balance braided with cotton and paraffined; part of the conductors to be covered with tinfoil, and part twisted in pairs for metallic circuit; also a single conductor of No. 13 B. & S. gauge braided and paraffined. We believe this was the first underground experiment made for the American Bell Telephone Company, and the laying of this cable was a red letter day for us. One Sunday in 1882 the American Bell sent an engine and one open-end freight box car, which carried the 5 miles of cable we had already made to Attleboro, as well as fifty men for a working force. The cable was made in sections about 500 feet long, the sections being connected by means of junction boxes. It was laid in the space between the two tracks of the Boston & Providence Railroad, and extending from Attleboro depot eastward to a cable hut erected upon the land adjoining the track at a point 5 miles distant from the depot. In laying this cable a trench was started by means of pick and shovel, but it was soon found the hard road bed was by no means easy digging. A plow was borrowed of one of the farmers and attached to the outrigger from the truck of a car, pulled by an engine. As we were unable to hire oxen or horses to plow with in puritanical Attleboro on Sunday, this idea was suggested by W. H. Sawyer, and it made a fine specimen of plowing, the like of which was probably never before witnessed. When the trench was completed, two plows had actually been consumed in the process. The cable was placed at the end of the car and paid out into the trench as the car moved along, and close behind the plow in the furrow. It was comical during this plowing to see how gingerly the man holding the plow commenced. He took hold of the tip end of the handles, ready to instantly jump in case the plow should strike a sleeper, which went clear across between the two tracks. It worked so nicely that the furrow had not gone many hundred feet before the man was sitting on the handles with another man riding on the beam of the plow, sinking the latter completely into the ground. The filling of the trench was also another great conundrum; the gang started with shovels and hoes to do this, but it at once became evident that it would be a week's work with the force at command. Again Sawyer's inventive genius came to the rescue. At his suggestion a joist was procured, and one end lashed to the cowcatcher of the engine, the other end extending out over the trench on the side where the dirt had been thrown. The engine was started, and the same temerity was again exhibited with the man adjusting the end of the joist to push back the dirt. At first he held it with a stick, but after a little two men were riding on the joist, and the entire length of the trench and cable was soon covered, much to the pleasure and satisfaction of those looking on as well as those responsible for the filling. As it was Sunday we were all rather blamed from a moral standpoint by the pious people of Attleboro.

At this time customers were not nearly as particular as to size and quality of insulation. Both of these points have been given very great attention. Better insulation was required in some cases, thinner by others. All sizes of wire were called for in longer lengths without joints; where 20 or 25 pounds in one length had been accepted, ½ mile or 1 mile pieces are now expected. Wire had been considered near enough to size if it could be dropped or forced in the numbered slot of a Brown & Sharpe gauge. Now it is required to be measured by a micrometer within a thousandth of an inch of a stated size. The demands of the underwriters are constantly growing more exacting, and at the present time a foot of wire selected from a coil of No. 14 rubber-covered wire purchased in open market must stand a puncture test of 9000 volts; the whole coil an insulation test of 100 megohms per mile during thirty days' immersion in water. Such a test requires the manufacturer to be alive and on the constant lookout for imperfections in his work.

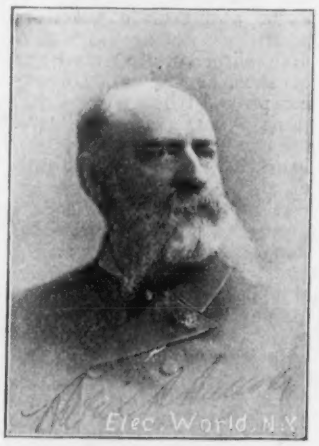
The electric light and electric railway systems installed within the last few years have largely increased the output of electric wires. The quantity used in these heavy-weight wires has had its great effect on the rapid increase of copper stocks noticed throughout the country recently. The aggregate in pounds of feeder cable alone, if presented, would be something startling. The question often arises with those connected with the business as to what becomes of all the wire manufactured. Those who have been in the business for twenty-five years and have noticed the increase, which has been far beyond their expectations, can but poorly predict for the future, but without doubt the oft-repeated remark that the "electrical business is as yet in its infancy" applies to the manufacture of bare and insulated electric wire as well. The output of the American Electrical Works in dollars and cents is now about the same, every two and one-half days, as it was for the whole of the year 1874.

Experiences in the Early Days of Telegraphy.

To the Editor of The Electrical World:

Sir—Your request for a personal reminiscence from me as an old-time telegrapher, covering the telegraphic work about 1874, has been duly received and favorably considered. But, my dear young sir, 1874 is a too recent date for an antique like me. If you had asked for 1848 you would have come nearer my opening.

The most interesting feature of my practical experience in telegraphy was back yonder before the Secession War, when the American Telegraph Company, under Mr. Eddy, in the East, and the Western Union Telegraph Company, under Wade & Sibley, in the West, were bringing the detached lines into united connection with improved conditions to a common centre at New York City. Then it was that your correspondent was assigned the duty of breaking into the close arrangement of the magnetic and House printing lines from New York to Washington and the South. By uniting several wildcat local lines across New Jersey we succeeded in a roundabout way in securing one wire connection between New York and Philadelphia, and put in operation what was known as the Hughes instrument, all other patents being owned by the old companies. With this light foundation we cut the rates in half, and with "25 and 2" soon brought the monopoly to terms, and a consolidation of interests, which gave the public better service at lower rates, was soon effected.



RUFUS B. BULLOCK.

The patents being in this way consolidated, I joined the best features of the House and Hughes printing instruments by drawings into a combination printing instrument. This suggestion was adopted and put into practical operation by the wonderful mechanical skill of Mr. George M. Phelps. The same mechanical idea was afterward embodied in the fire-alarm systems and in the well-known "Ticker," and is still the most practical printing telegraph apparatus in existence.

It is very gratifying for one of the earliest in the profession to note the wonderful improvements which have rendered the service to the public almost perfect.

With best wishes for the youthful ELECTRICAL WORLD, now just turning its first quarter of a century, I am, yours fraternally,

RUFUS B. BULLOCK.

ATLANTA, GA.

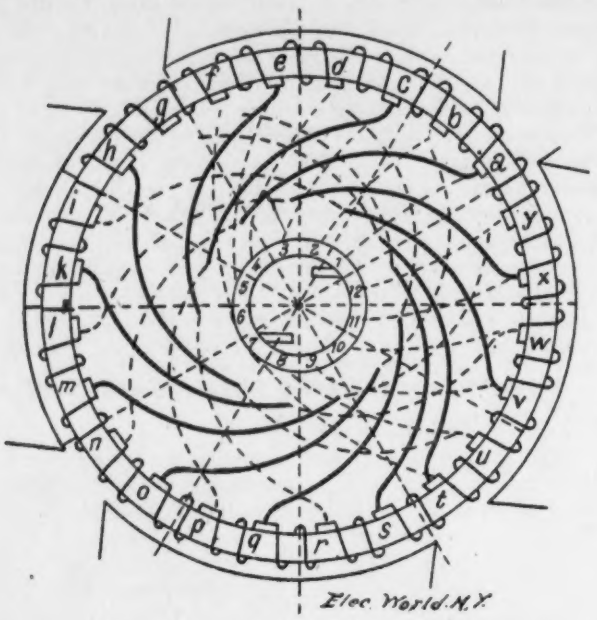
DIGEST OF CURRENT ELECTRICAL LITERATURE AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

ALTERNATOR FOR LOW FREQUENCY.

For very low frequencies of any desired amount, Van Depoele suggested revolving the brushes of a continuous-current dynamo; but this involves inconveniences, which are claimed to be overcome by the system of the Union Company, of Berlin, which is described in "L'Eclairage Elec.," Jan. 28. Referring to the adjoining diagram of a four-pole machine, it will be seen that the winding is



like that of a continuous-current machine; but it has cross connections and such connections to the commutator that the neutral points are not always under the brushes, but revolve with a speed depending on the method of connecting. There are only two brushes, as shown. During a complete rotation the neutral point has moved twice around the commutator and in the opposite direction; a new period will therefore be begun at each revolution of the armature. At a certain moment the voltage between the brushes will be a maximum, and as the armature revolves some of the windings will tend to produce currents in the opposite direction, only the difference appearing at the brushes; this will continue until the voltage is zero, after which it will again develop in the opposite direction, the current, therefore, being an alternating one. The method is not limited to single-phase currents, but can also be used for polyphase currents, or for transforming the frequency or the phases; for instance, with the machine in the diagram shown, by using two other brushes at 90°, diphase currents, with a frequency equal to the number of revolutions, will be produced. It may be furthermore modified by using slide-ring connections in addition, thus enabling a number of transformers to be made.—"L'Eclairage Elec.," Jan. 28.

STARTING CONTINUOUS-CURRENT MOTORS.

In an abstract of a recent paper by Mr. Vogelsang on the action of continuous motors and the arrangements for starting them, which is published in the "Elek. Zeit.," February 2, and which seems somewhat elementary, it is stated that large shunt motors of the Helios Company, which had to be started under specially difficult circumstances, are made with a special compound starting winding in order to increase the starting torque; this compound winding is only used during the period of starting, and is then cut out as the motor increases its speed. The device has been very satisfactory, and is an improvement which involves no great cost, as this winding may be made of relatively thin wire, because the current flows through it for only a very short time. Another device of the same company is briefly described, in which the arrangement for starting is automatically moved to the starting position, if for any reason the current from the central station should be stopped, in order to avoid injuring the armature when this current is started again. In the discussion, Dr. Sieg stated that the compound starting winding above mentioned has been in use for some time on the Krieger automobiles in Cologne.—Vogelsang. "Elek. Zeit.," Feb. 2.

REFERENCES.

Starting Non-Synchronous, Single-Phase Motors.—A reprint of an article from the Italian, discussing mathematically the effect which the total resistance in each circuit of the armature has on the form of the curve showing the couple of a non-synchronous, single-phase motor. The authors show how to find the critical resistance indicated by Arno; also how, knowing the maximum couple and the resisting couple, to find the best resistance of the armature—that is, the one for which the speed to be given to the motor at starting is a minimum.—Maffiotti and Pescetto. "L'Eclairage Elec.," Jan. 28.

Theory of Single-Phase Motor.—The first part of an article on oscillatory and rotary magnetic fields, and a theory of the single-phase motor, which was prepared over four years ago. The chief object of the paper is to investigate the analyses and syntheses of various forms of magnetic fields, with a view to arrive at a satisfactory standpoint from which to attack the theory of the single-phase motor and to develop an approximate method for calculating it.—Field. Lond. "Elec. Rev.," Feb. 10.

Theory of Armature Windings.—A short, mathematical article deducing a general formula for the winding of continuous-current armatures. Among other things the formula, which is quite simple, gives the number of conductors on the armature which are required under given conditions in order that a closed-circuit winding becomes possible.—Westphal. "Elek. Zeit.," Feb. 9.

Commutation in Dynamos.—The beginning of a long, mathematical article on the short-circuiting of the coils and the commutation of the currents for a continuous-current armature. No conclusions of importance which could be given in abstract are drawn in the present portion.—Arnold and Mie. "Elek. Zeit.," Feb. 2.

Exciting a Dynamo with Half of Its Voltage.—A long abstract, with a number of illustrations, of the article noticed in the "Digest" Sept. 3.—Sengel. "L'Eclairage Elec.," Feb. 4.

Lights and Lighting.

THE NERNST LAMP.

In an editorial reference to the paper of Swinburne, on the Nernst lamp, which was reprinted in THE ELEC. WORLD last week, attention is called to the fact that the author was very reticent regarding the relative merits of the lamp on alternating and continuous-current circuits. The lamps shown were connected to alternating-current mains, and he merely added that they would also run with continuous current. It appears, however, that electrolysis must take place, and with continuous currents more frequent renewals of the lamps will therefore be necessary. A possible explanation of the life of the magnesia rods in this case may be that the product of electrolysis, magnesium, is immediately ozidized on coming in contact with the air, and owing to the high temperatures the newly formed magnesia is carried back along the rod by the diffusion which he says takes place. This would explain the inability of the continuous-current lamp to burn in a vacuum, as was alluded to in his reply to the discussion.—Lond. "Elec.," Feb. 10.

In the discussion of Swinburne's paper, which is reprinted in abstract in the Lond. "Elec. Eng.," Feb. 10, Dr. Fleming called attention to the fact that in the use of the calcium light it was found that the light speedily diminished, although the temperature was unchanged, and he suggests that there may be a similar deteriorating quality in the oxides of the present lamp. Mr. Colefax said that he had recently seen Dr. Nernst, and that the filaments did not, as far as he was able to discover, deteriorate in use.

As a matter of interest in connection with this lamp, the German patent to Jablochkoff, dated Aug. 14, 1877, and alleged by some to anticipate this invention, is reprinted in "Zeit. f. Beleucht.," Feb. 10.

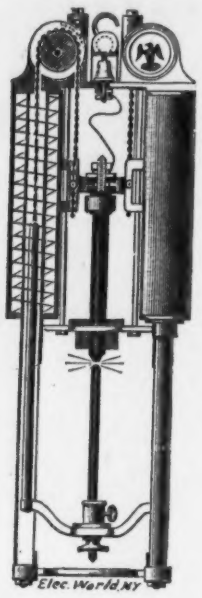
SUPPLYING TESTED INCANDESCENT LAMPS.

According to the Lond. "Elec. Eng.," Feb. 10, a company in London has been established for supplying tested lamps to the general public, of any desired types, thus saving the trouble and annoyance of consumers in having to test them themselves, or from being imposed upon with poor lamps. The company guarantees that all lamps which have been stamped with their mark, which is a glow-beetle, shall give the candle power specified to within 10 per cent., and the watts per candle to within 7 per cent.; also that the vacuum is good, that the filament shall be uniform throughout and free from cracks and flaws, and that the lamp shall last at least a definite number of hours. It recommends that where the charge exceeds 10 cents per unit no lamps should be allowed to remain in circuit more than 500 hours. The lamps as received from the makers or other companies are first subjected to a test for the vacuum, and for this purpose they are placed on a traveling belt, which conveys them through an alternating electrostatic field of a predetermined intensity in a dark room, where an observer picks out those that show by glowing that their vacuum is defective; the really good lamp is practically invisible. They are then tested for continuity of filament and flaws by applying intermittent currents, which cause the weak spots to glow first. They are finally tested for candle power and current consumption. These last two operations are to be carried out simultaneously, and experiments are now being made with a revolving disc equipped with a number of hold-

ers into which the lamps are to be placed, and by means of which each lamp comes opposite to the photometer in turn; if the candle power and efficiency are within the prescribed limits, the lamp is properly stamped. The current for all these tests is taken from two batteries of accumulators, each of 80 cells and 60 ampere-hours' capacity. A room is also equipped for making life tests for purposes of record. All the lamps which do not pass these tests are returned to the makers. What the additional charge is for these tested lamps is not stated.—Lond. "Elec. Eng.," Feb. 10.

NEW ARC LAMP.

What appears to be a novel form of arc lamp having some interesting features is described in the Lond. "Elec. Rev.," Feb. 10, and is followed by the results of tests made by a number of different parties. The lamp is known as the A B C arc lamp, and is for direct or alternating currents; it is claimed to be the cheapest and most reliable arc lamp on the market, and the simplest in construction ever introduced; it can be used for series or parallel lighting, and is claimed to be absolutely self-adjusting. It is less liable to get out of order, as there is no clockwork, brake arrangement or mechanical device. The duration of the carbons, for an equal length of the body of the lamp or the carbons, is said to be equal to twice that of any other lamp, and it can also be adapted for long runs of 100 to 150 hours without the necessity of enclosing the arc (but how this is done is not described). Referring to the accompanying illustration, it will be seen that the lamp has a mantle or block near the end of the upper carbon, composed of a patented chemical material not further described. It surrounds the burning arc, and may be enclosed in a small opal glass globe. This is claimed to increase the lighting power of the arc by 30 per cent., or, in other words, to save about one-third in current; and it increases the life of the carbons by 50 per cent. The mantle is rendered incandescent by the arc, and gives a very powerful diffused light, securing steadiness and diminishing the sharpness of the shadows considerably. The construction of the lamp will be seen from the accompanying figure, in which the spiral represents one of the shunt solenoids, each of which is encased in a wrought-iron shield, closed at each end by an iron washer, thus forming an iron-clad magnet. The respective weights of the upper carbon holder, with its chains, and of the lower one, with its iron cores, are so calculated that the latter are heavier than the former, and the length of the chains and of the cores, respectively, are so adjusted as to allow the upper extremity of the cores to slightly engage with the solenoids when the upper carbon is at its highest point. The wrought-iron cross-piece or yoke at the lower extremity of the iron cores forms, with the latter, a horseshoe magnet of opposite poles at the upper ends, thereby producing a more powerful pull, one which is said to be constant whatever the respective positions; this is claimed to be an important point. When the current is first turned on it will go entirely through the solenoids, as the carbons are not in contact; this brings them into contact, short-circuiting the shunt solenoids, which allows the carbons to drop and start the arc, the length of which is regulated by the position of small pawls on the notched pulleys at the top of the lamp. There is said to be a variation of only two volts at the terminals of the lamp. The results of some tests made by Grindle are reproduced; they were made first without the mantles and then with them, showing that there is a very marked saving in the carbon when the mantles are used, the saving in weight being slightly over 46 per cent. The duration of the lamps was extremely satisfactory, and the steadiness was very marked. Some other tests showed that the use of the mantle increased the illuminating power considerably at an angle of 45°.—Lond. "Elec. Rev.," Feb. 10.



REFERENCES.

Arranging Arc Lamps for Street Lighting.—A brief discussion of whether the lamps should be arranged alternately on each side of the street, and descriptions of some of the methods in use.—Lond. "Elec. Eng.," Feb. 10.

Arc Lamps.—Numerous brief and well-illustrated descriptions of improvements taken from patent specifications.—Richard. "L'Eclairage Elec.," Feb. 4.

Power.

STEAM TURBINE ALTERNATOR.

A brief, illustrated description of two turbo-alternators of 1000 kw each, which are being constructed by Parsons for the lighting station at Eberfeld, in Germany, is published in the Lond. "Elec. Eng.," Feb. 10. These machines are said to be the largest which have yet been made by anyone ,and it is expected that their efficiency will also surpass the record. They are designed for 4000 volts, at a speed of 1500 revolutions and a frequency of 50. The turbines are of the horizontal flow type, and there will be modifications in the arrangement of the governors, the electrical governor being combined with a Proell governor capable of hand adjustment, this being necessary because the alternators are to be run in parallel with each other, and with other engine-driven alternators. The electric governor is to control the voltage within 1 per cent. when 25 per cent. of the load is suddenly thrown on or off. With a steam pressure of 170 pounds and 50° of superheat, not more than 24.25 pounds of steam are to be required per kw hour at full load, or 26.5 at half load. The alternator is of the four-pole type, with a drum type of armature, the conductors being buried in the iron core, thus giving great mechanical strength to stand the centrifugal force. The design is naturally simplified by the high speed; the designers have guaranteed that on a non-inductive load the fall in voltage between no load and full load shall not exceed 6 per cent. The exciter is mounted on the same shaft. The whole weight, including the condenser, air pump and pipes, will be about 85 tons. The small amount of floor space required is said to be remarkable, but unfortunately no figures are given.—Lond. "Elec. Eng.," Feb. 10.

WATER POWER OF THE CHICAGO DRAINAGE CANAL.

The "Eng. News," in its issue of Feb. 23, calls attention editorially to the proposals for utilizing the water power of that drainage canal, considering it a most inviting opportunity for capitalists. It is now proposed to lease the water power, and a copy of a letter sent out by the trustees to this effect is reprinted.—"Eng. News," Feb. 23.

REFERENCES.

Water Powers in Southern California.—An article in which the author, who seems to have had considerable experience in that region, points out the essential considerations which relate to water powers in Southern California; it is chiefly for the benefit of those financially interested in such investigations. Attention is called to the exaggerated reports of promoters and the great variation in the amount of water in streams in that country.—Baldwin. "Jour. of El'ty," Jan.

Alternating-Current Transmission.—The second and third parts of the long article noticed in the "Digest" Jan. 28. Synchronizing alternators for parallel coupling, and the properties of induction machines, are discussed.—Leblanc. "L'Eclairage Elec.," Jan. 28 and Feb. 4.

Electrically Operated Derrick.—A reprint of the whole paper describing this derrick at Newport News, an abstract of which was noticed in the "Digest" Feb. 18. The present description includes a double-page plate of working drawings.—Post. "Eng. News," Feb. 23.

Water-Power Plant in the Niagara Gorge.—The complete paper, an abstract of which was noticed in the "Digest" last week. The paper is short, and almost all of the data contained in it was given in our abstract last week.—Birkinbine. "Proc. Eng. Club Phila.," Feb.

Water-Power Project.—An abstract of a recent paper giving estimates of a projected water-power plant utilizing the fall of the Roer in the Rhine province, Germany.—Intze. "Zeit. f. Elektrochemie," Feb. 2.

Rainfall at San Francisco.—A table giving the rainfall in that district for each month from 1849 to date, which is of interest in connection with neighboring water-power plants.—Manson. "Jour. of El'ty," Jan.

Traction.

CALCULATION OF THE POWER REQUIRED FOR ELECTRIC RAILWAYS.

In a long paper, which is reprinted in the "Elek. Zeit.," Feb. 2, Mr. Schroeder describes in detail a method for calculating the mean power (as distinguished from the maximum) which is required for an electric railway on which a number of cars are running at regular intervals; it is necessary to know this when the station contains a battery. He shows how the power for each car, on each grade, is calculated from the usual formulas, and then, with the aid of a profile of the road, and the usual diagram used in railroad work, indicating the successive departure and arrival of cars, he deduces the following convenient rule: In order to determine the mean power per second for all the cars together, calculate the energy which is required by one car for one whole return trip and divide this by the time in seconds in which one car follows the other in the same direction—that is, by the time, in seconds, of the car intervals. In these calculations all grades below 1.2 per cent. may be neglected and considered as level. He assumes that the traction coefficient is 12 kg per ton. This is followed by an example of the complete calculation of an electric railway system using a stationary battery.—Schroeder. "Elek. Zeit.," Feb. 2.

ELECTRIC AUTOMOBILES.

In a lecture by Mr. Egger, a reprint of which is begun in the "Zeit. fuer Elek.," Jan. 29, and which is of a general character, some data is given which may be of interest. He claims that the axle friction is larger than is generally assumed, and may be as high as 20 kg per ton. An average value of about 10 kg per ton can be assumed for electric automobiles weighing about 1500 kg at a speed of 15 kilometres per hour. The air resistance with the relatively low speeds is not of much importance, but this is not true of the wind pressure, which has a great effect, as the resistance increases with the square of the velocity of the wind. At a speed of 1 metre per second the wind pressure on 1 sq. m. is 0.14 kg; or, at 6 m. per second, it is 4.87 kg, and at 30, which corresponds to a serious storm, it is 122 kg. In general the traction coefficient may be taken at about 50 kg, but of course this varies very greatly with the nature of the road. In many cities grades of 9 to

10 per cent. are encountered, and automobiles should be prepared to mount them.—Egger. "Zeit. fuer Elek.," Jan. 29.

APPLICATION OF BALL BEARINGS TO RAILWAY CARS.

Last week an article was noticed in the "Digest," referring to the use of ball bearings on the street-railway cars. In the "Elek. Zeit.," Feb. 9, Mr. Schiemann supplements this with his experience in the construction of roller bearings, which have been in experimental use for some time. He had concluded that the pressure on the balls of a ball bearing would be too great, even with a number of rows of balls, and he therefore determined to use rollers instead. These were arranged so that they were parallel to each other (not slightly inclined, as in some American forms, for the purpose of taking up wear). He used ordinary cast-iron boxes, which were carefully polished, and the best results were obtained with rollers made of rods of drawn bronze. If a saving of 18 per cent. was obtained with ball bearings, he thinks that with roller bearings as much as 10 to 15 per cent. might be saved, as there is more sliding friction in these than in ball bearings.—Schiemann. "Elek. Zeit.," Feb. 9.

REFERENCES.

Wilkesbarre.—A brief, illustrated description of the interurban line from Luzerne, Pa., through Dallas to Harvey's Lake, which is notable for several features, its tortuous course involving many heavy grades through the mountains, its power-station machinery, the alternating-current transmission lines, and its success, both from a financial and operating standpoint, in a case where a steam railroad failed.—"St. Ry. Rev.," Feb. 15.

Two-Speed Traveling Platform.—Some brief references to trials which are just taking place of an experimental line in Paris constructed for the exhibition authorities, for determining the construction of such a platform for the exhibition of 1900.—Lond. "Elec. Rev.," Feb. 10, and N. Y. "El'ty," Feb. 22.

Twin City Rapid Transit Company.—A long, illustrated description of the power house and shops of this railway between Minneapolis and St. Paul, including a description of the water-power plant at St. Anthony Falls.—"St. Ry. Rev.," Feb. 15.

Surface-Contact System.—A brief, illustrated description of the Guest system, in which the conduit is sealed, contact being made with the aid of surface contacts actuated by a magnet carried by the car.—N. Y. "Elec. Eng.," Feb. 16.

Bar Contact.—Illustrations of the details of the overhead bar-contact system for making connection with trolley wires, as used by Siemens & Halske, are given in "Zeit. fuer Elek.," Feb. 5.

Pittsburg.—An illustrated description of the new power station, shops and pleasure resort of the Consolidated Traction Company in Pittsburg.—"St. Ry. Rev.," Feb. 15.

Lausanne.—An abstract, with some of the data, of the article noticed in the "Digest" Jan. 7.—Preller. "St. Ry. Rev.," Feb. 15. (Lond. "Engineering.")

Mixed System of Electric Traction in Paris.—A brief abstract of the paper noticed in the "Digest" Dec. 31.—Marchena. Lond. "Elec.," Feb. 10.

South Side Elevated Railway.—Extracts from the recent report of President Carter, showing very favorable results.—N. Y. "Elec. Eng.," Feb. 16.

Installations, Systems and Appliances.

CONNECTING THREE-PHASE ALTERNATORS IN PARALLEL.

In coupling alternators in parallel it is convenient to know which of the two machines is running faster just before they are coupled. An arrangement for showing this, which is used by the Siemens & Halske Company, is described in "L'Elec.," Jan. 28, under the heading of a phase comparer. It will appeal to the station manager because the signal given is a very convenient one. The arrangement is shown in the adjoining figure, and consists essentially of the two switches, both of which are connected to each of the three-phase alternators, as is shown with only the first alternator to the left, the other connections being omitted for the sake of clearness; these switches are for connecting any one of the alternators with the three lamps shown near the middle of the figure; the voltmeters at the top are for adjusting the voltage. The three lamps are behind a ground-glass screen, so that they are seen only indistinctly when lit, and the action of the two alternators to be coupled, when they are not quite in synchronism, will be to illuminate these three lamps in succession, so that the light shining through the glass will appear to revolve in one direction or the other, and from this direction it will be seen which of the machines is running at the greater speed. When the alternator *I* is running, and *I I* is to be connected with it, the voltage is first adjusted, and the switch *B* is then placed on the knobs corresponding with alternator *I I*, while switch *A* is connected with *I*. When the direction of rotation of the light is that of the arrow *f*, then alternator *I I* is revolving more rapidly than *I*, and vice versa. The machines are to be coupled at the precise moment when the upper one of the three lamps is extinguished, as that means that they are in synchronism at that moment; this lamp may also be connected to the voltmeter, as shown, so as to indicate this point with greater precision. For high-voltage alternators the voltage for the lamps must first be reduced, either by means of transformers or by connections with a few of the windings of the alternator.—"L'Elec.," Jan. 28.

REFERENCES.

High-Voltage Switch and Fuse.—Brief, illustrated descriptions of the Verity and the Steele high-tension switches and fuses are given in the Lond. "Elec. Eng.," Feb. 10. In the former the high-tension parts are all on the back of a slab of marble, through which the switch plates pass. The principle of the fuse is that of quenching the arc by means of oil, the weight of the tube and the oil being supported by fuse wire.—Lond. "Elec. Eng.," Feb. 10.

Para.—A long, well-illustrated description of the central station in this city in Brazil, and in which 2000-volt alternating currents are used, the plant being installed by the Siemens & Halske Company.—Hoest. "Elek. Zeit.," Feb. 2.

Wires, Wiring and Conduits.

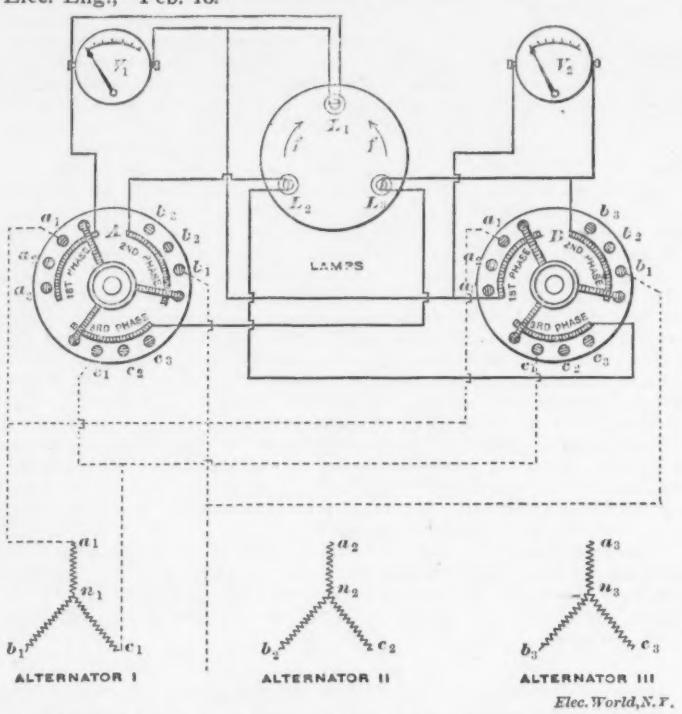
NEW AIR SPACE TELEPHONE CABLE.

What is thought to be a great advance in the direction of air-space cables is the use of a certain new material to replace the paper. This is called "leno," and is an open-work gauze cloth held together by starch glaze. It was devised by Mr. Hall, and is briefly referred to in the Lond. "Elec.," Feb. 10. The material is cut in narrow strips, and is applied to the wire longitudinally with a spiral of thread to keep it together. In spite of the thinness of the gauze, no trouble has been experienced from short circuits. Some tests made with such a cable are given briefly and compared with those of a paper cable. Each cable contained fifty-two No. 19 copper wires; the outside diameter of the leno cable was 1.37 inches. The mean capacity in microfarads per mile, "all other wires to lead," was 0.0668 for the leno cable, and about 0.077 for the paper cable, the insulation in megohms per mile being 2000 and 5000, respectively.—Lond. "Elec.," Feb. 10.

REFERENCES.

Interior Electric Wiring.—An article describing in detail the way in which the wiring of a frame-house of moderate cost should be carried out, using the simple method of porcelain knob and tube works, and including a few rules applying to such work.—Gardner. "West. Elec.," Feb. 18.

House-Wiring Regulations.—A much longer abstract, with an illustration, of the paper by Pigg, noticed in the "Digest" last week and Feb. 18, is published in the Lond. "Elec.," Feb. 10. A reprint, which is apparently in full, is also continued in the Lond. "Elec. Eng.," Feb. 10.



Elec. World, N. Y.

The Capacity of Telephone Cables.—A reprint of a long paper describing a method of calculating the electrical capacity of telephone cables with twin wires.—Breisig. "Elek. Zeit.," Feb. 9.

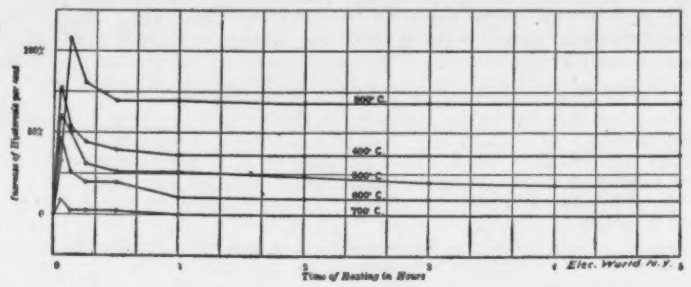
Electro-Physics and Magnetism.

EFFECTS OF PROLONGED HEATING ON THE MAGNETIC PROPERTIES OF IRON.

Some time ago (see "Digest," July 2), Mr. Roget read a paper before the Royal Society describing his experiments to show the change in the value of the hysteresis of soft iron transformer plates when subjected to continued baking at temperatures not exceeding 200° C. He has since continued the experiments, using higher temperatures up to 700° C., the results of which are given in abstract, including a number of the curves, in the Lond. "Elec.," Feb. 10. The same specimens were used as in the former experiments, namely, soft Swedish iron transformer plate, which had been re-annealed. The baking was carried on in specially constructed electric ovens, and a number of short runs at various high temperatures were also taken. The general features of the action are similar to those no-

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN 277

ticed before at moderate temperatures, and are shown in the accompanying diagram. The initial rise of hysteresis is more rapid the higher the temperature, but the subsequent fall takes place sooner and the final state is one of lower hysteresis the higher the temperature, until at about 700°, a temperature just short of that required for complete annealing, the hysteresis falls again to its original value, after a very short time. At temperatures above this no traces



of any rise have been observed. It was found that the susceptibility to change at moderate temperatures is not by any means entirely removed by a prolonged heating at high temperatures, but the subsequent action of low temperatures was slower than in freshly annealed iron, especially after the high temperature had been applied for a considerable time; it also appeared that 500 or 600° C. produced less effect on the susceptibility to subsequent change at lower temperatures than was produced by more moderate degrees of preliminary heating. The latter part of the action at the higher temperatures resembles an incomplete annealing. Some other curves show how widely different the behavior of different brands of steel and iron is when subjected to this treatment. A sample of a "non-aging" plate showed that if this iron was annealed before use in a transformer it would ultimately, through low-temperature heating, show much more hysteresis than if left in the state in which it was submitted by the manufacturer. From these and other tests it seems that brands of transformer steel which are practically non-aging are obtainable commercially, but they are not of such low initial hysteresis as the Swedish iron, which was formerly considered the best material for transformers. In conclusion he summarizes briefly the chief effects of prolonged heating, as follows: "1. Material in the annealed state is more liable to change than in a harder state. 2. All the changes produced by prolonged heating are completely removed by re-annealing. 3. The heating need not be continuous; the same cumulative effect is produced by a number of short periods at a given temperature as by a continuous heating at the same temperature. 4. The effect may be regarded as being due to two actions superposed, one tending to increase the hysteresis, this action being the prominent at lower temperatures; the other, analogous to an incomplete annealing, tending to decrease the hysteresis, this action predominating at higher temperatures. 5. The liability of the material to increase in hysteresis at moderate temperatures is not removed by prolonged heating at high temperature. 6. The change is confined to the lower part of the B H curve, the saturation value of the magnetization being substantially unaltered. 7. The effect is produced equally, whether the iron is or is not exposed to the air during heating."—Roget. Lond. "Elec.," Feb. 10.

THEORY OF THE EARTH'S MAGNETISM.

Recently Professor Trowbridge advanced a new theory to account for the earth's magnetism, which was described in the "Digest" Jan. 14. This is criticised in "Science," Feb. 17, by Professor Bauer, a well-recognized authority on earth's magnetism. He shows that as the north end of the compass-needle points toward the north, the currents suggested by Trowbridge must be in the reverse direction—that is, from west to east. But as the magnetic needle dips, Ampere's rule again shows that the current would have to go from east to west. To account for both of these, Trowbridge's currents would have to move simultaneously in contrary directions, or, in other words, those currents do not explain the actions of the needle. If electric currents produce the observed phenomenon of the compass, including the dip, they cannot be in the atmosphere, but must be inside of the earth's crust, and proceed from east to west. The fact that the causes of the earth's magnetism must be almost entirely within the earth's crust was shown mathematically by Gauss fifty years ago, and has been amply verified since. The earth's magnetic force consists of three parts; the greatest one is due to causes within the earth's crust, and possesses a potential; the smallest part, about one-fortieth of the entire force, is due to causes outside of the earth, and likewise possesses a potential; and, thirdly, a somewhat larger part than the preceding one, which does not possess a potential, and therefore points to the existence of vertical earth-air electric currents, which amount, on the average, to one-sixth of an ampere per sq. km. In a brief reply by Professor Trowbridge, he states that he imagined the electric currents to be largely localized at the region of the astronomical poles, and that the earth as a whole was paramagnetic; this he explains briefly with the aid of a diagram. —Bauer. "Science," Feb. 17.

CHEMICAL ACTION OF X-RAYS.

In a recent paper before the French Academy, Mr. Villard showed that the action of light on a platino-cyanide screen was exactly the reverse of that of X-rays, and that it destroys the effect produced by these. Among other experiments, he states that if the exposure of a sensitive plate be slightly exaggerated and X-rays be allowed to act on it, some of them being screened by a lead plate producing a negative image, then, under the action of the light, this image will disappear little by little and then reappear in the inverse sense, becoming much more visible. If the action of the light is prolonged, solarization will follow, and the image will again be lost; after this it will again re-appear reversed—that is, a negative; if then developed, a positive image will be obtained. Other experiments are described showing the destructive action of light rays.—Villard. "L'Eclairage Elec.," Feb. 4.

REFERENCES.

Effect of Pressure on the Conductivity of Solutions.—An abstract of an article describing extended tests. Some of the results are given; for distilled water, for instance, the percentage rise in conductivity for 500 atmospheres is nearly 40 per cent.; it seems to vary quite greatly with different solutions.—Bogojawlensky and Tammann. "Zeit. Phys. Chem.," 27, p. 457; abstracted in the "Zeit. f. Elektrochemie," Feb. 9.

Nature of X-Rays.—A theory of X-rays is offered by Walter, in the "Wied. Ann.," 64, p. 74, an abstract of which is published in the "L'Eclairage Elec.," Feb. 4. According to him, the Roentgen rays are cathode rays which have lost their charge and consist of particles which are diffused from the anti-cathode after they have lost their electrification.—Walter. "L'Eclairage Elec.," Feb. 4.

Expression for the Energy of a Circuit.—A reprint of a short French Academy paper, deducing the expression for the energy in the circuit of a coil and applying it to the attraction of an armature to its magnet.—Perot. "L'Eclairage Elec.," Feb. 4.

Experiments with Kites.—Some brief remarks concerning his experiments with the collection of atmospheric electricity by means of his large tandem kites.—Eddy. N. Y. "Elec. Rev.," Feb. 22.

Thevenin Theorem.—A short, mathematical demonstration of this theorem with an application to the discussion of Mance's method.—Pomey. "L'Eclairage Elec.," Jan. 28.

Experiments with Coherers.—A brief description of some experiments with the action of coherers.—Dell. N. Y. "Elec. Eng.," Feb. 16.

Physics and Electrical Engineering in 1898.—A reprint of the article noticed in the "Digest," Feb. 18.—N. Y. "El'ty," Feb. 22.

Electro-Chemistry and Batteries.

SELLING PRICE OF VERY RARE METALS.

The following list of selling prices of metals more expensive than gold may be of interest to electricians in view of the fact that some of them may in future be obtained much more cheaply by electrical processes. The figures were given in the "Mining and Scientific Press," and are reprinted in the "Elek. Anz.," Feb. 5: Gallium, 787,500 francs per kg (a franc is about 20 cents); vanadium, 123,750; rubidium, 112,500; thorium, 95,600; glucinum, 66,000; lithium, lanthan and calcium, 56,250; indium, tantalium, yttrium and didynium, 50,650; strontium, 48,200; erbium, 42,100; ruthenium, 30,900; niobium and rhodium, 28,100; barium, 22,500; titanium, 12,650; zircon and osmium, 11,940; uran, 11,250; palladium, 6,430; tellurium and chromium, 5625, and gold, 3444 francs per kilogram. It will thus be seen that there are twenty-six elements which are more expensive than gold, gallium, the most expensive, being 230 times as valuable as gold; the very common metal calcium is eighteen times as expensive as gold.—"Elek. Anz.," Feb. 5.

DISSOLVING NOBLE METALS IN ELECTROLYTES.

A method was recently described by Mr. Margules by means of which platinum and gold may be dissolved. In the "Wied. Ann.," 64, p. 540, abstracted briefly in "L'Eclairage Elec.," Feb. 4, he supplements this with a description of a simple method for dissolving platinum in sulphuric acid. This is done with the aid of a revolving commutator, which leads the current into the voltameter and then short-circuits the latter, the process being repeated continuously. No dissolution will take place if the ordinary make and break of an interrupter be used, but if a current be passed through the voltmeter from another battery while the first circuit is opened, and of the opposite signs to the first current, then platinum will be dissolved at the anode of that current which has the greater intensity. This second current is not necessary when the rotating commutator is used. Gold and platinum behave in entirely different ways when subjected to this treatment.—Margules. "L'Eclairage Elec.," Feb. 4.

AGING BRASS BATHS.

It has often been noticed that with a freshly prepared bath for brass plating the deposit is at first quite poor, but improves with use. This improvement is hastened by boiling or passing a current through it, but a quicker and simpler method is described by Peters in a paper which is abstracted in the "Zeit. f. Elektrochemie," Feb. 9. It consists simply in adding to the freshly prepared bath some chloride of tin. In a cyanide bath containing ten litres of water, for instance, besides the other ingredients, he adds 40 grams of chloride of tin; this will immediately form a white precipitate, which will remain suspended in the liquid a long time, and when it settles the bath must be stirred; this should be continued until the bath has been in use for some time. The chloride of tin need not be absolutely pure, the commercial product being sufficiently so. The voltage at the bath is 3.5 and the current density 1.7 to 1.8 ampere per sq. dm.—Peters. "Zeit. f. Elektrochemie," Feb. 9.

ACCUMULATOR CONSTRUCTION.

In this continuation of his long serial, he describes briefly some of the Planté plates in use. He calls attention to the danger in

using nitric acid previously to the formation, in order to "open the pores of the metal," a process which was tried and condemned by Planté, and has since been adopted by others. He believes that a perfected process of depositing peroxide from a solution of alkaline plumbate seems likely to afford excellent results. The ultimate dangers following the use of nitric acid cannot be too strongly impressed upon both manufacturers and users of secondary batteries. —FitzGerald. Lond. "Elec. Eng.," Feb. 10.

PRODUCTION OF GLUCINUM.

With the aid of compounds of fluorine, this metal, also known as beryllium, may be obtained from minerals containing it. Beryllium minerals containing oxygen are mixed with fluoride of calcium in pulverized form, together with a flux of alkaline earths, and are then subjected to electrolysis while fused. Carbon is used for the electrodes, although under circumstances metal, such as copper, iron or beryllium, may be used instead. Some further details concerning this process are given by Liebmann in the "Zeit. f. Elektrochemie," Feb. 2.

NEW PRIMARY BATTERY.

A note stating that a cell may be made of cobalt and tin in sulphuric acid with bichromate of potash; cobalt is the positive pole, and the cell is said to give a strong current, but how much and at what voltage is not stated. Without the potash solution a weak current will flow in the opposite direction. The original description is in the "J. Russ. Chem. Ges.," 30, 11.—Wischnegorsky. "Zeit. f. Elektrochemie," Feb. 2.

REFERENCES.

Bleaching and Disinfecting.—Some extended tests made on a large scale by Prelinger with the Kellner process, including also estimates of the cost and the saving, are published in the "Oestrr. Chem. Zeit.," and in abstract, including data, in the "Zeit. f. Elektrochemie," Feb. 9.

Electrolytic Conductivity of Pure Substances.—A short article in which the author explains the justification of the law announced by Kohlrausch, that at ordinary temperatures no pure liquid has an appreciable electrolytic conductivity.—Abegg. "Zeit. f. Elektrochemie," Feb. 2.

Elektrochemical Theory.—A third installment of the article by Mewes, and a short article on the hydrolytic dissociation and thermo-chemistry by Platner, are published in the "Elektrochem. Zeit.," Feb.

Electrometallurgical Laboratory.—A translation of the brief description of the laboratory at Aix-la-Chapelle Polytechnic, which was noticed in the "Digest" Dec. 3.—Lond. "Elec. Rev.," Feb. 10.

Production of Caustic Soda.—A reprint of the article noticed in the "Digest" Feb. 18.—Robertson. N. Y. "Elec. Eng.," Feb. 16.

Primary Batteries.—A reprint of the note referred to in the "Digest" Feb. 18.—Petersen. Lond. "Elec.," Feb. 10.

Analyses of Lead Compound.—Descriptions of electrolytic processes.—Hollard. "L'Elec.," Feb. 11.

Units, Measurements and Instruments.

INTERRUPTER FOR INDUCTION COILS.

Still another modification in a make and break for an induction coil, which seems to have some advantages, is described by Mr. Dessauer, in the "Zeit. f. Elektrochemie," Feb. 2. In the usual form the contact is broken by means of a spring, which vibrates in front of the end of the core of the primary, breaking contact as it is drawn toward the core. This he modifies by arranging a second and similar contact on the opposite side of the spring—that is, the side toward the magnet, the contact being then made and broken at each end of the oscillation of the spring, instead of only at the end of a double oscillation. It would at first seem that when the circuit is made by this additional contact the magnet would hold the spring in that position, which therefore would keep the circuit closed; but he shows that this is not the case, as the power of the spring to return to its middle position is generally nearly as great as that of the magnet. The advantages of this improvement are as follows: For producing the same frequency of interruptions, the apparatus need oscillate only half as rapidly as the ordinary one, which involves a longer duration of contact, therefore giving longer sparks of greater intensity; each contact-point will be subjected to only one-half of the wear of that with a single contact—that is, the life will be doubled. For the same number of oscillations of the spring the number of sparks will be doubled, and the duration of contact will be the same as with the former apparatus at half the frequency. For all the later uses of the coil, such as for Roentgen ray tubes, Hertzian waves, etc., this simple modification may therefore be applied with advantage.—Dessauer. "Zeit. f. Elektrochemie," Feb. 2.

MEASURING THE PHASE SHIFTING IN THREE-PHASE MOTORS.

A method, which is claimed to be new, for determining the phase shifting in three-phase motors, is described by Dr. Breitfeld in the "Elek. Zeit.," Feb. 9. In three-phase circuits in which each of the three branches have exactly the same resistance and self-induction, and in which the form of the voltage curve is truly sinusoidal, the phase shifting between the voltage and the current, in one of the circuits, may be determined with a single wattmeter with two different connections of the movable winding to the three-phase circuits. The series winding is connected in the circuit carryng the current, whose phase shifting is to be measured, and the shunt circuit is connected with one pole to one end of the series winding and with the other first to one of the two remaining circuits, and then to the other, the reading of the wattmeters being taken in each case. He then shows, by a simple mathematical calculation, that the tangent of the angle of the phase shifting is equal to the square root of 3, multiplied by the arithmetic difference of these readings, divided by their sum. This formula contains the values of the readings, and for this measurement an exact knowledge of the constant of the wattmeter is therefore not necessary, provided that the instrument is used in the same way for both the readings. It appears that this deduction is a theoretical one, and that he has not had an opportunity to apply it in practice.—Breitfeld. "Elek. Zeit.," Feb. 9.

EXAMINING MAGNETIC FIELDS BY MEANS OF CATHODE RAYS.

In an article by Braun, noticed in the "Digest" April 23 (under the heading of "Rotating Fields"), a method was described for studying the curve form, phase shifting, etc., of alternating currents by means of cathode rays. Mr. Seefehlner, in the "Elek. Zeit.," Feb. 9, praises this method very highly and describes an application of it to the examination of the fields of various alternating current motors. Unfortunately the description is not very clear, and is not accompanied by illustrations describing the application. It appears that he wound a wooden core Gramme ring, through which the current to be measured was passed, and placed this ring over the Braun vacuum tube. Among other applications he states that the cathode rays offer a means for determining the "form factor" of an alternating current directly without a knowledge of the curve form. If first the alternating current is sent through the indicator coil and then a continuous current, being both measured with the same hot-wire instrument and regulated so that both the currents are equal, then the ratio of the deflections of the spot of light with the continuous current to half the amplitude of oscillation of the alternating current, will give the desired form factor, namely, the relation of the maximum to the effective current strength.—Seefehlner. "Elek. Zeit.," Feb. 9.

CALORIMETRIC DETERMINATION OF THE LOSS IN CONDENSERS.

In the "Digest," Feb. 4, attention was called to an article by Messrs. Rosa and Smith on the determination of the energy lost in condensers, as measured by means of a wattmeter. In a subsequent article by them in the "Phil. Mag." for Feb., they describe a totally different method, which was used to confirm these results and to measure the energy dissipated in some paraffin condensers in which the loss was so small that it could not be measured by the other method. The present method is a purely calorimetric one, and is described, together with the results. Those for beeswax and resin condensers were confirmed by this method, the percentage loss varying from about 5 to 8 per cent. An interesting fact observed was that the residual charges of these condensers are very large, and increase with the temperature up to 40° C., after which they decrease again. The maximum point of this residual charge is the same as for the energy lost. The paraffin condensers which were measured were some made by Stanley. The percentage loss in one of these at a frequency of 28 was only 0.78 per cent., or 1 per cent. with five times this frequency.—Rosa and Smith. "Phil. Mag.," Feb.

TESTING CABLES.

The method of reversals described by Mr. Black in the article noticed in the "Digest," Feb. 4, is criticised briefly by Mr. Murphy, in the Lond. "Elec.," Feb. 10. He claims that it is not always safe to assume that the polarizations of the batteries and earths will be the same when the flow of the testing current is in one direction and then in the other, even if the time intervals are equal, nor for currents of similar sign after reversal. The errors, as a rule, may not be large, but they may be avoided by inserting a milli-ammeter in the battery circuit and accepting the balance, not at equal intervals of time, but only when the testing currents have settled down to some given constant value. Reversal methods should be used sparingly and with caution, as they are reliable only when the battery line and earths are practically perfect, and they should be used, as a rule, only as a check method on perfect cables. They should not be used to prevent obtaining the training and practice necessary for the successful application of "E. C." zero tests.—Murphy. Lond. "Elec.," Feb. 10.

COMMERCIAL INDICATING INSTRUMENTS.

In a recent paper by Shoults, abstracted in the Lond. "Elec. Eng.," Feb. 10, he discusses questions connected with reliable but cheap instruments for commercial use. The paper does not seem to be of special value, but a table which he gives contains some figures of interest; it gives the force used in various instruments expressed as the torque per watt in grams at 1 cm radius, and also the watts used in the active part of the instrument. For the Kelvin balance the former was 29.19 and the latter 70.9 watts; for a number of other instruments, chiefly voltmeters, the torque averaged from 0.15 to 0.4, and the watts a little over 1, the degrees of deflection of the scale being from 70 to 75; they do not differ much from each other, but are very different from the figures in the Weston instruments, which are as follows: The torque 472, the watts 0.0012 and the deflection 84°, thus showing that with a greater range of deflection the torque is enormously greater and the watts used very much less.—Shoults. Lond. "Elec. Eng.," Feb. 10.

REFERENCES.

Hysteresis Meter.—A short Academy paper, in which the author claims that the one recently devised by Blondel and Carpenter (see "Digest," Jan. 21,) is identical in principle with one he designed more than fifteen years ago, although it was not constructed until much later.—Deprez. "L'Elec.," Feb. 11.

Connections of Thompson Recording Wattmeters.—A reprint from the General Electric Company's catalogue of the diagrams showing the internal connections of these instruments for various purposes and circuits.—N. Y. "Elec. Eng.," Feb. 16.

Electrolytic Interrupter.—A translation, with the illustrations, of the article noticed in the "Digest" last week.—Wehnelt. N. Y. "Elec. Eng.," Feb. 16.

Simple Galvanometer Tests.—A short, elementary description of the ordinary tests made by telgraphers.—Davis. "Teleg. Age," Feb. 16.

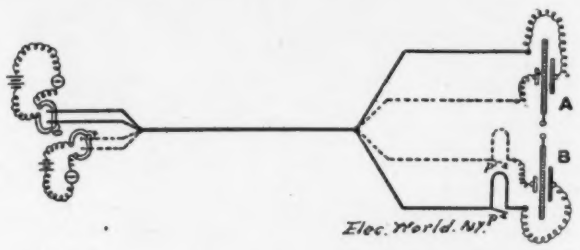
Telegraphy, Telephony and Signals.

THE PROGRESS IN TELEPHONY AND TELEGRAPHY.

A large part of the February issue of "Elec. Eng'ing" is devoted to a long article by Mr. Clement, in which, after giving some general figures, he describes, with the aid of illustrations, a large number of recent improvements, taken, apparently, from patent specifications; most of the article is devoted to these technical descriptions. He states that it is estimated that the total capitalization of the electrical industries in the United States now approaches 2,000,000,000, of which telegraphic investments amount to about $150,000,000 and the telephonic $125,000,000. No figures exist showing what proportion of this represents the increase for the past year, but the Bell Company, which at the beginning of the year had an estimated capitalization of $20,000,000, has probably added $5,000,000 more. The general substitution of copper for iron wire on lines has continued, and there are now over a million miles of telegraph lines on about 200,000 miles of pole lines (presumably referring to the United States alone). The progress in telephony is said to have been remarkable. There are at present about one million telephones in use, with 900,000 miles of wire; one writer estimates the growth of the independent interests to be at the rate of 500 instruments per day.—Clement. "Elec. Eng'ing," Feb.

MULTIPLEX COMMUNICATION.

In a recent French Academy paper, published in "Comptes Rendus," No. 26, and abstracted briefly in Lond. "Elec.," Feb. 10, Mr. Turpin describes a method of simultaneously telegraphing and telephoning between any two stations on a single line, the problem being solved by means of Hertzian waves, which are concentrated by one or two wires. The general arrangement is shown in the accompanying diagram, intended for two different receiving stations.



A and *B* are two equal oscillators, which compensate each other under ordinary circumstances, when the two bridges, *p* and *p'*, are closed, but when one or both are open, one or both of the distant resonators will respond. It was found that separate wires were not necessary as long as the circuits are separated by a short length at each end, and that these lengths, at the receiving end, are equal to half the wave-length of the corresponding oscillator. Experiments which were made were a complete success, some messages being received by means of resonator sparks and the others by telephone and the Morse recorder. The distance was 170 metres, and it was found that none of the ordinary careful insulation was necessary.—Turpain. Lond. "Elec.," Feb. 10.

TELEPHONES IN HAWAII.

In a short, popular article on the use of the telephone in the Sandwich Islands, reprinted in the "West. Elec.," Feb. 18, from a daily paper, Mr. Rhoads gives some interesting information concerning the use of the telephone in that country, which is much more extended than is generally supposed. It is claimed that perhaps nowhere in the world is the telephone a greater factor in life than in Hawaii, where there are about 2000 telephones to a population of 110,000, or one telephone to every fifty-two inhabitants. On the island of Oahu, on which Honolulu is situated, there are 1090 telephones for a population of 45,000, or about one to forty-one inhabitants. Such an event as the arrival of a steamer, which is a very important piece of news, is repeatedly announced from the telephone exchange, so that anyone interested need only listen at his 'phone to hear the name and location of the steamer. In the same way any striking piece of news of general interest is given to everybody who calls up for connection.—Rhodes. "West. Elec.," Feb 18.

REFERENCES.

Modern Bridging System.—A short article from a recent telephone handbook. (As abstracts from this same book appear to be published weekly in that journal, they will not be noticed again specifically).—Webb. "West. Elec.," Feb. 18.

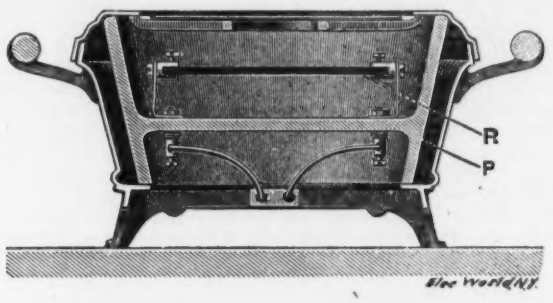
Duplex Telegraphy with a Recorder.—A short description of the action of the syphon recorder, followed by a discussion of the duplexing of messages through cables by means of it.—Luers. "Elek. Zeit.," Feb. 2.

Submarine Survey.—The conclusion of the long article describing the methods of making surveys for submarine cables.—Bright. Lond. "Engineering," Feb. 10.

Miscellaneous.

HEATING APPARATUS.

Heating Apparatus.—In the construction of electric heating apparatus many advantages are gained by generating a large amount of heat in a small mass—that is, by using high temperatures. The advantages are well recognized, among them being that less heat is absorbed by the apparatus itself; the heating is done more quickly, therefore reducing the cooling losses, which continue during the length of time of the heating process, etc.; moreover, such apparatus could then be used for roasting or broiling where high temperatures are necessary. Moreover, it is generally at the end of an operation that the highest temperature is required, and all of the heat in the apparatus itself is then lost after it is turned off. To overcome these objections, the new heating material has been devised by Mr. Parvillee, a description of which is given in "L'Eclairage Elec.," Jan. 28, and more briefly in "L'Elec.," Feb. 11. The rods in which the heat is developed are made of a metallic powder mixed with fusible clay, the whole being compressed and heated to a high temperature, thus giving rods of very high resistance and of great strength. The metal should be pulverized, and it was found that nickel, on account of its high melting temperature, is the one best adapted; the powdered metal is mixed with quartz, kaolin and a binding material, and is compressed with 2000 kg per sq. cm, after which it is dried and baked at a temperature of 1350° C. By altering the proportion of the metallic powder in the mixture, the resistance may be modified to any extent, or it may be made high in the middle of the rod and low resisting at the ends, where it is attached, thereby causing more heat to be generated in the middle. Such a rod, 5 cm long, 1 cm wide and 0.3 cm in thickness, has a total resistance of 100 ohms, which is said to be a million times that of the metal used; the material can absorb 16,500 watts per kg. For an equal surface, as compared with other materials in use, it will develop fourteen times the heat per unit of surface that the best of the other materials will give (presumably referring to wires). The temperature which it can stand is sufficiently high for melting a copper wire when touched to it; the rods may be heated to a red heat for 1400 hours without showing any trace of deterioration. The temperature to be produced is regulated by adjusting the number of these rods in circuit. These resistances, therefore, meet the conditions required for heating apparatus, as mentioned above. The price of these rods for absorbing five amperes at 110 volts is estimated not to exceed 60 cents, and the complete apparatus, being much simpler, is considerably cheaper than the ordinary ones in use. In one of these it is said that a quart of water can be boiled in five minutes, with 15 amperes, at 110 volts. As will be seen from the adjoining illustration, representing a cross-section of a cooking



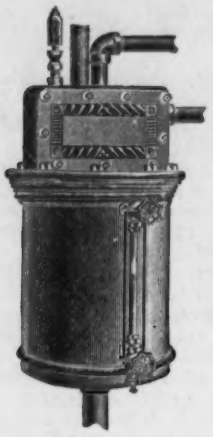
device, the rods *R* are held in copper clamps, which are flexibly connected with the binding posts, so as to allow for expansion; the rods are easily replaced. *P* represents the porcelain vessel, which at the same time acts as a reflector of the heat. It is said that at a cost of 8 cents per kw hour the cost of broiling three cutlets would only be 0.3 cent per cutlet.—"L'Eclairage Elec.," Jan. 28, and "L'Elec.," Feb. 11.

PROGRESS OF THE ELECTRICAL INDUSTRY.

A few figures of interest, showing the progress in the construction of dynamos, are given in the inaugural address of President Dumont, of the French Society of Civil Engineers, a reprint of which is begun in "L'Elec.," Feb. 4. The weight of dynamos, he says, has diminished to 43 kg per kilowatt for outputs of 100 kilowatts, and to 36 kg for outputs of 2000 kilowatts. The price, which exceeded 20 cents per watt in 1882, has diminished to 4 cents for machines of 10 kilowatts, to 3 cents for those of 100 kilowatts, and to 2 cents for machines of an output of 2000 kilowatts. Non-synchronous, polyphase motors have been developed to such an extent that their efficiency is equal to that of continuous current motors, and their price is as low as 6, and even 5, cents per watt. He estimates that there are at present at least 250,000 generators and motors constructed annually, varying from 3 kgm to 5000 horsepower, and that the capital in the electrical industries in the world is more than five million francs, of which at least one-half is in America.—Dumont. "L'Elec.," Feb. 4.

Automatic Steam Pump Regulator and Low Water Alarm.

This device, which is manufactured by the Burrows Manufacturing Company, 141 West Third Street, Williamsport, Pa., is illustrated in the accompanying cut, and a brief reference to its operation and advantages will no doubt be of interest to central station and power house managers. This apparatus has been subjected to severe tests extending over a period of years, and is recommended to steam users as having attained a high degree of perfection in steam-boiler appliances for safety, economy and regulation of the feed-water delivered to the boilers. The claims made for it are that it effects a marked saving in fuel; gives better protection to both boiler and engine than is afforded by any other device; the impossibility of flooding the boiler if the feed pump is run in connection with the regulator; the maintenance of a standard level of the water in the boiler, which level cannot be reduced more than 2 inches below a given point without sounding an immediate alarm; and, finally, its use gives a uniform steam space in the boiler and dry steam for the engine.



Regulator and Low Water Alarm.

The machine, which is said to be the result of years of patient study and scientific investigation, is claimed to be accurate and extremely simple. It is substantially constructed, and is not liable to get out of order. Repairs are easily effected and at small cost. The regulator is made in three sizes, 6, 8 and 10-inch, the former being suitable for any power up to 100 hp; the 8-inch size for powers up to 200, and the 10-inch size for any power up to 600 hp.

The Burrows Company is so confident of the satisfactory working of this device that it will furnish one on trial to any responsible person.

A System of Electric Lighting for Railway Cars.

The convenience of the car axle as a source of power for the electric lighting of cars on steam railway lines has led to the development of several systems utilizing axle-driven generators. On account of the occasional stoppage of the car accumulators are a necessity, and to avoid the bad voltage regulation caused by the change of electromotive force of the accumulator between a charging and discharging state two complete sets of batteries have generally been considered necessary, one to be charged while the other is discharged. In the system described below but one set of accumulators is used, which can be much smaller than either one of the two sets necessary with a double equipment, as it is alternately charged and discharged for short intervals with the rise and fall of the speed of the train. The regulation of the voltage has been ingeniously effected, and an interesting solution has been found for several other problems, such as the automatic cutting in and cutting out of the dynamo as the speed exceeds or falls below the minimum working limit, and its regulation to give constant voltage under a wide range of speed.

The generator is a bipolar machine with a steel magnetic circuit, shunt wound, and enclosed with some of its regulating devices in a dust-proof case. It is mounted on the truck of the car as shown in Figs. 1 and 2, with a suspension resembling very much that of street-car motors, the nose being swung in a stirrup from the truck frame, the other end slung on the axle. In order to make the apparatus applicable to existing car axles, unturned and untrue, with the wheels wedged tightly upon them, it is fitted with a split sleeve, shown in Fig. 4, each end gripping the axle by means of adjustable jaws, constituting an arrangement very much like a chuck. By means of these jaws the sleeve can be trued up regardless of any irregularity of the axle. The generator is slung on bearing rings running in grooves in this sleeve, its weight resting through two spring buffers in chambers which are shown clearly in Figs. 3 and 5. Any variation of the distance between the generator shaft and the main axle is prevented by slides between the bearing rings and the frame.

The device for reversing the connections of the armature of the machine, on

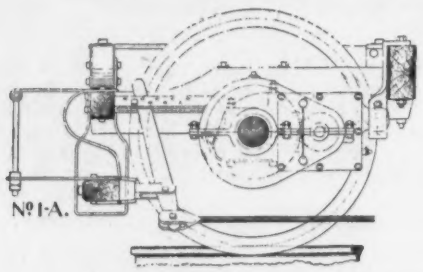


Fig. 1.

reversal of the direction of the motion of the train, is mechanically operated in a way that will be clear on inspection of Fig. 5. A worm on the armature shaft engages with a worm gear which rotates a switch cam. This throws a six-pointed switch in one position when the train is running in one direction and in the other position when the train is running in the other direction, the movement reversing the connections of the armature terminals of the generator.

The machine is shunt wound, its fields being excited constantly from the storage battery, the controlling apparatus (with the exception of the switch just described) being located within the car on a small table shown in Figs. 6 and 7, which may be placed at any convenient location where the attendants can always get at it. There are two main features to be looked after by this apparatus, one the cutting in and out of the generator, and the other the control of its field strength. The former is handled by an automatic switch which appears in the upper left-hand corner of Fig. 6 and in the background of Fig. 7. The contacts are A-shaped and operated by a double magnet, the two lower poles of which are shunt wound and connected across the armature terminals and the two upper poles are series wound and connected into the circuit between the generator and the storage battery when the switch is closed. As the machine voltage rises the magnetism of the lower poles builds up until it pulls the switch to the closed position, when the machine voltage is equal to that of the storage battery. The current then flowing from the machine to the battery holds the switch in the closed position until the machine falls to such a low speed that it cannot counteract the battery electromotive force when this current reverses, opposing the magnetization of the lower poles, and allowing the switch to be opened by a spring.

To the right of this switch there may be seen a small Lundell motor which is constantly in operation, oscillating through a worm, worm wheel and cam, a pair of pawls which may engage respectively with one or the other of a pair of oppositely toothed ratchet wheels on the vertical central shaft. The engagement of one or the other pole or neither is determined by the armature of the solenoid shown to the left, the windings of which are connected in series between the battery and the generator. The rotation of the central shaft cuts in or out the sections of a Wirt enamel rheostat in series with the shunt field of the generator; thus in case the charging current from the generator becomes stronger, due to a rise in speed of the train, the armature of the solenoid is drawn in against the opposition of the spring shown, one pole is allowed to engage with the teeth of the corresponding ratchet, and (rocked by the motor) it inserts resistance into the field circuit until equilibrium is restored. In case the speed falls the opposite action takes place.

In the lower left-hand corner of Fig. 6 may be seen another rheostat face

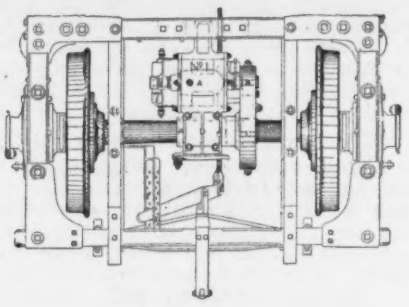


Fig. 2.

plate with six points. This is connected with a band-iron rheostat on the under side of the table shown in Fig. 8, the whole being in series with the lamp circuit. The arm is operated by a cam on the central shaft, which cam also increases the tension on the spring opposing the pull of the armature of the solenoid. The arrangement is such that as the speed of the generator rises, increasing its electromotive force and tending, therefore, to increase the charging current, the cam cuts in resistance in the lamp circuit, increasing the drop in the same to correspond with the increased electromotive force of the storage cells due to the charging current passing through them. The tension on the spring is also increased, requiring a stronger pull and more current for any further movement of the main shaft which, in turn, cuts in more resistance in the lamp circuit. The whole equipment is designed for a constant load, and the resistance in the lamp circuit is not made adjustable with the load, but in case of the equipment of cars for a variable load the switches throughout the car, by which the lamps are turned on or off, are fitted with resistances in shunt with that just described, in order to render the drop constant. Between the small motor and the main automatic switch there will be noticed another magnetic switch which appears clearly in Fig. 6. The coil of this is connected in series with the lamp circuit and its contacts cut out a part of the turns of the main solenoid, so that when the lamps are on more current is automatically generated by the machine than when the lamps are off.

The operation of the devices as a whole is as follows: Assuming that the train is running below normal speed, say twenty miles an hour, the automatic switch is opened, the machine being cut off from the battery. There is, of course, no currrent through the solenoid, since this is in series with the automatic switch and its restoring spring has operated to engage one pawl which has cut out all resistance from the field circuit of the generator as well as all resistance from the lamp circuit, the lamps getting the full electromotive force of the storage battery. As the speed rises the automatic switch closes, the current flows through the solenoid which attracts its armature, engaging the pawl which turns the main shaft in such a direction as to cut resistance into the field circuit to limit the charging current as well as into the lamp circuit to take up the increased electromotive force of the cells. More and more of these resistances are cut in as the speed and charging current rises.

The battery installation and rating of the dynamo is dependent, of course, upon the extent of the illumination and the voltage of the lamps. Pullman cars are equipped with 16, 20 or 32 cells, according to the number of lights. On the Canadian Pacific Railway ten new sleepers have been equipped with this system. These cars were especially built for trans-continental service. Each is equipped with twenty cells of chloride accumulators, with Manchester plates, having a capacity of 240 ampere-hours. Each car is lighted by sixty-three 8-cp 38-volt lamps. A Pullman car on the Pennsylvania Railroad is lighted by 60-volt 16-cp lamps, the car being equipped with 32 cells of battery. On this car the "Syracuse" battery is used, and it is stated that it has made a remarkably good record for durability and all round service. The company uses 2½-watt Imperial lamps in its installation.

The patents under which the machines are designed are those of Mr. P. Kennedy, the apparatus being built and installed by the United Electric Company, of 14 Stone Street, New York.

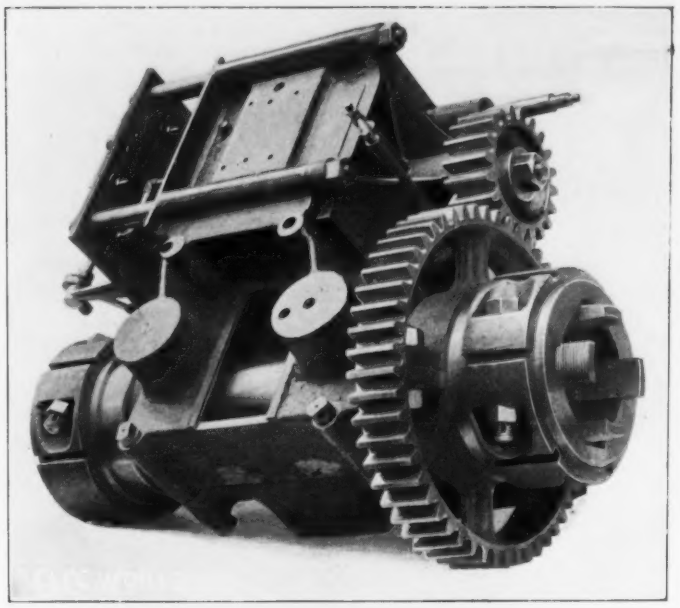


Fig. 3.—The Generator.

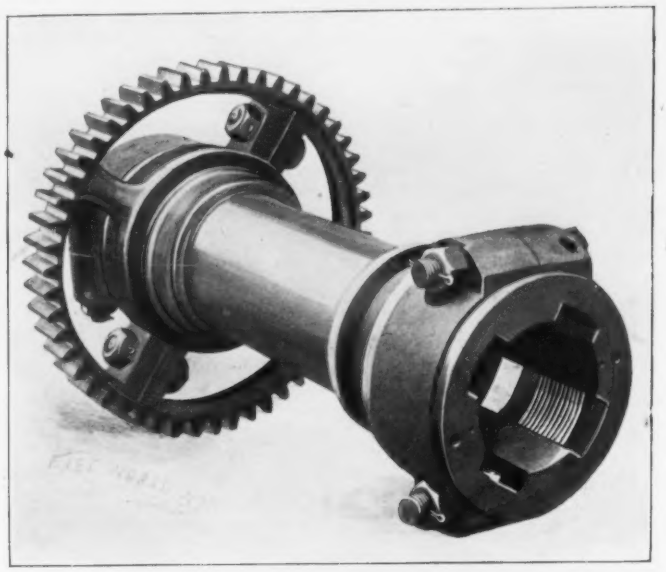


Fig. 4.—Split Sleeve and Driving Gear.

Fig. 5.—Pole-Changing Device.

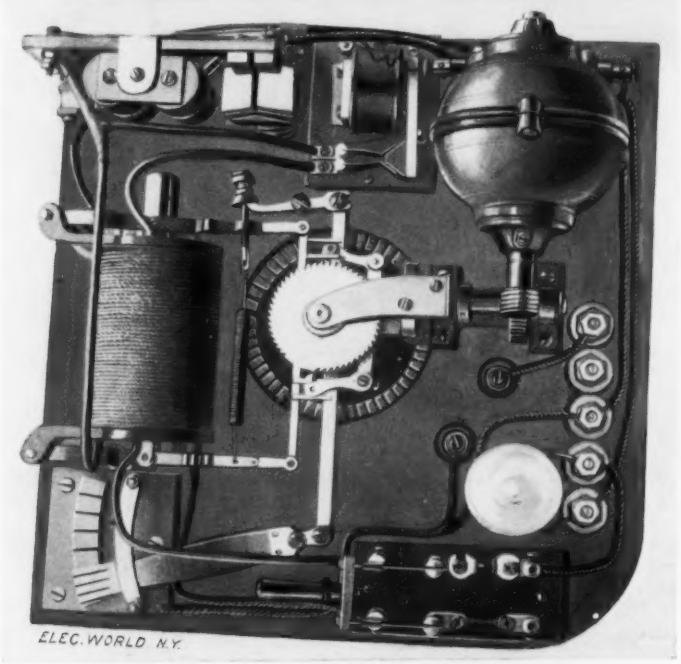


Fig. 6.—Top View of Controlling Apparatus.

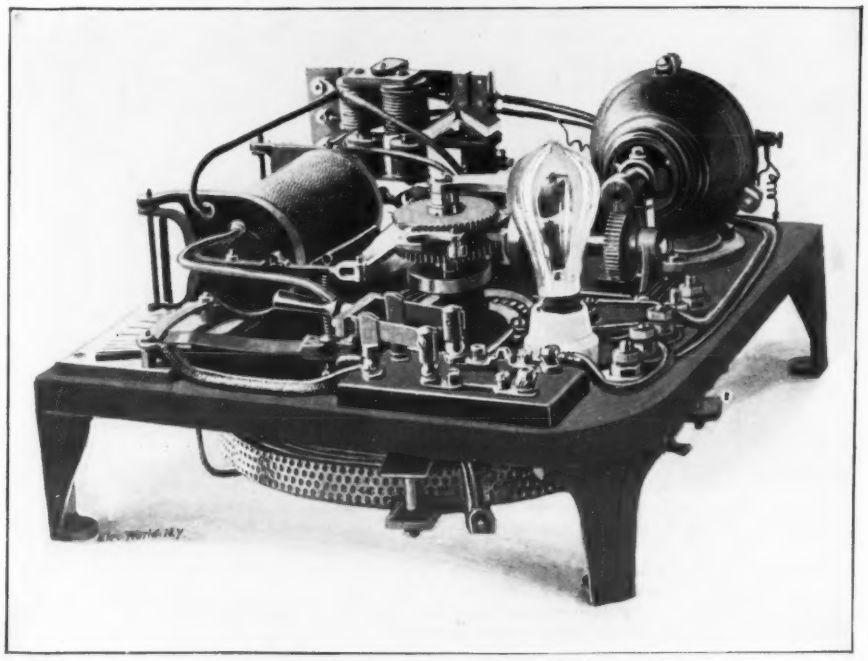


Fig. 7.—General View of Controlling Apparatus.

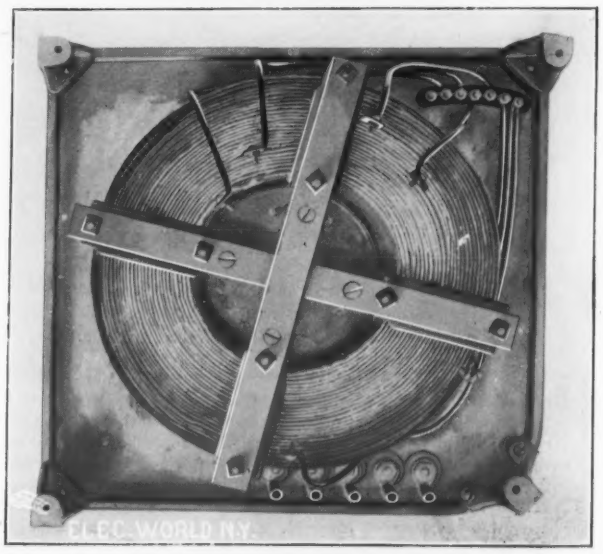


Fig. 8.—Band-Iron Rheostat in Lamp Circuit.

An Electrical Cooking School.

The use of electric current in connection with the culinary art is one of its most recent applications, and, notwithstanding its great and manifold advantages, has been somewhat tardy in obtaining general recognition and appreciation. The public has recently become quite familiar with the idea of using electricity for cooking purposes, and a description of the cooking plant of the Oread Institute in Worcester, Mass., will be of general interest at this time.

The outfit is a very complete one, and its installation is due to the foresight and wisdom of Mr. H. D. Perky, the founder and president of the institution. Current for every cooking appliance, as well as for lighting, is furnished by a 37½-kw Westinghouse direct-current 110-volt dynamo driven by a belt from a Westinghouse engine. The installation of the electric plant was intrusted to the Page Electric Company, of Worcester, Mass., and the electric cooking appliances

THE PRACTICE KITCHEN.

were furnished by the American Electric Heating Corporation, of Cambridge. The practice kitchen, where instruction is given, is a circular apartment some 35 feet in diameter, in the centre of which is a fountain, and around this, leaving space for the teacher, is a circular, slate-topped bench or counter upon which the students can work at the gas and electric stoves in the course of the lessons. For the electrical portion of the equipment are 24 plug sockets connecting the stoves and heaters by flexible cords. The form of these heaters is such that they can be used for heating anything that can be placed on a flat, hot surface. The 6-inch size takes 440 watts. A smaller size (4½ inches) can be attached to any ordinary lamp socket, thus rendering it available for use in the sick room or the nursery. The plugs and receptacles are made especially by the American Electric Heating Corporation for this class of work and are designed to avoid heating at points of contact, and for safety.

In another portion of the room, against the wall, is a slate-top table, at the back of which are eight other plug receptacles adapted to make connection, by means of flexible cords and plugs, with the various devices on the table. The latter comprise an oven, so arranged that either the upper or lower portion, or both, can be heated at will, a thermometer being placed in the door to indicate the temperature within. A switch provides three different degrees of heat, the current used being either 16, 10 or 6 amperes, according to the temperature desired. The outfit includes also a chafing dish and double boiler combined, as well as

ELECTRICAL COOKING OUTFIT.

various stoves or heaters, the whole forming a very complete equipment for almost any demand that can be made upon it.

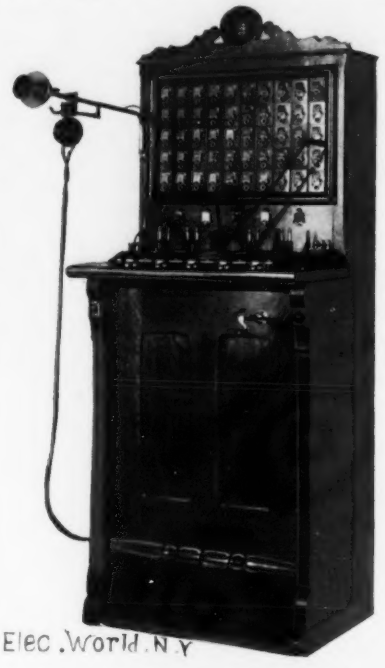
Two adjoining demonstration classrooms are provided with somewhat less elaborate but very complete equipment of electrical apparatus. From the 00 feeder cable which conveys the current from the switchboard to the different rooms tap wires connect to floor receptacles beneath the platforms on which the tables stand and on each table there are four plug receptacles, thus providing an arrangement of considerable flexibility and convenience. The utensils in the demonstration rooms comprise heaters, chafing dishes and ovens, and the special laboratory of Mrs. H. A. Higbee, the principal of the Institute, also contains a similar equipment.

The disposition and arrangement of the apparatus is the result of the personal supervision of Mr. James I. Ayer, manager of the American Electric Heating Corporation, in conjunction with the officers of the institution, and the general result is said to be of a most satisfactory nature.

A Metallic Circuit Telephone Switchboard of New Design.

The accompanying illustration shows a metallic circuit board of entirely new design, and the first turned out of the factory of the Kokomo Telephone & Electric Manufacturing Company, Kokomo, Ind. It was built for and installed in the factory of the Proctor & Gamble Company, Ivorydale, Ohio.

The Kokomo Company feels proud of it, and claims that it is the simplest board obtainable, having the least number of parts, less springs and trigger-work, and is yet the most rapid and smoothest operating switchboard of the "Ex-



METALLIC CIRCUIT SWITCHBOARD.

TELEPHONE SET COMPLETE.

press" type on the market. The company is not at liberty to give more detailed description of the board at present, on account of the fact that it is preparing applications for several patents thereon. A board of this type for the common-return system has been installed by the company at West Unity, Ohio, with a full equipment of telephones. This plant, it is stated, is receiving much praise from all who have had an opportunity to witness its operation.

The company reports meeting with excellent success with its telephones. The Proctor & Gamble Company, one year ago, ordered a Kokomo telephone, at the same time buying four instruments from other leading manufacturing companies. All five were connected up in the Proctor & Gamble exchange, and the five instruments were operated for twelve months. At the end of that time it was decided that the Kokomo instrument was the best of the lot, and the company placed an order for a full Kokomo equipment, metallic system switchboard, telephone and lightning arresters. The lightning arresters are built on a marble base, and the switchboard is the one illustrated herewith. The second illustration represents the Kokomo telephone set.

China and Glass Insulators.

The illustrations on the next page show a line of china and glass insulators and insulator pins, manufactured by Mr. Fred M. Locke, Victor, N. Y. Fig. 1 is a pin fixed to a galvanized-iron side bracket for attachment to the sides or buildings and similar places. This device is extremely substantial, and is said to be indestructible. Fig. 2 represents a No. 17 glass insulator for potentials up to 60,000 volts. Its diameter is 7 inches and it weighs 5 pounds. Mr. Locke states that there are 20,000 of these in daily use. The steel pin shown in Fig. 3 is provided with a porcelain base, and is adapted for high-voltage work. It is a very strong pin and said to be indestructible. By its use the arcing distance of the insulator is increased over 5000 volts. There are 100,000 of them in daily use. The No. 3 three-shell china insulator (Fig. 4), of which there are 75,000 in use, is designed for potentials up to 20,000 volts. The insulator is made up of three shells fused together with glaze. The diameter is 5½ inches and the weight 3½ pounds. Fig. 5 represents a No. 18 glass insulator for potentials of 25,000 volts and under. The distinctive features of this insulator are the eaves and the long centre petticoat. The diameter of the insulator is 5¼ inches and the weight 4 pounds. Another three-shell china insulator is shown in Fig. 6. It is the No. 4 style, and is recommended for potentials as high as 60,000 volts. There are said to be 20,000 of them in use. Its diameter is 7 inches, and weight 4 pounds. A two-shell china insulator is shown in Fig. 7. This insulator is designed for telephone and telegraph lines, and will safely carry pressures as high as 5000 volts. Its diameter is 3¼ inches and its weight 1½ pounds. It is stated that 100,000 of them are now used. Fig. 8 shows a new pony china insulator for telegraph and telephone lines, made from thoroughly vitrified, high-grade brown china; and Fig. 9 illustrates a two-shell china insulator for potentials up to 5000 volts. This insulator is designed for carrying street-railway cables and other conductors of large diameter. Its diameter is 3½ inches, and it weighs 1½ pounds. There are 30,000 of them in use now.

Mr. Locke has recently started a new factory in Victor, and it is now running successfully, turning out 10,000 china insulators per week.

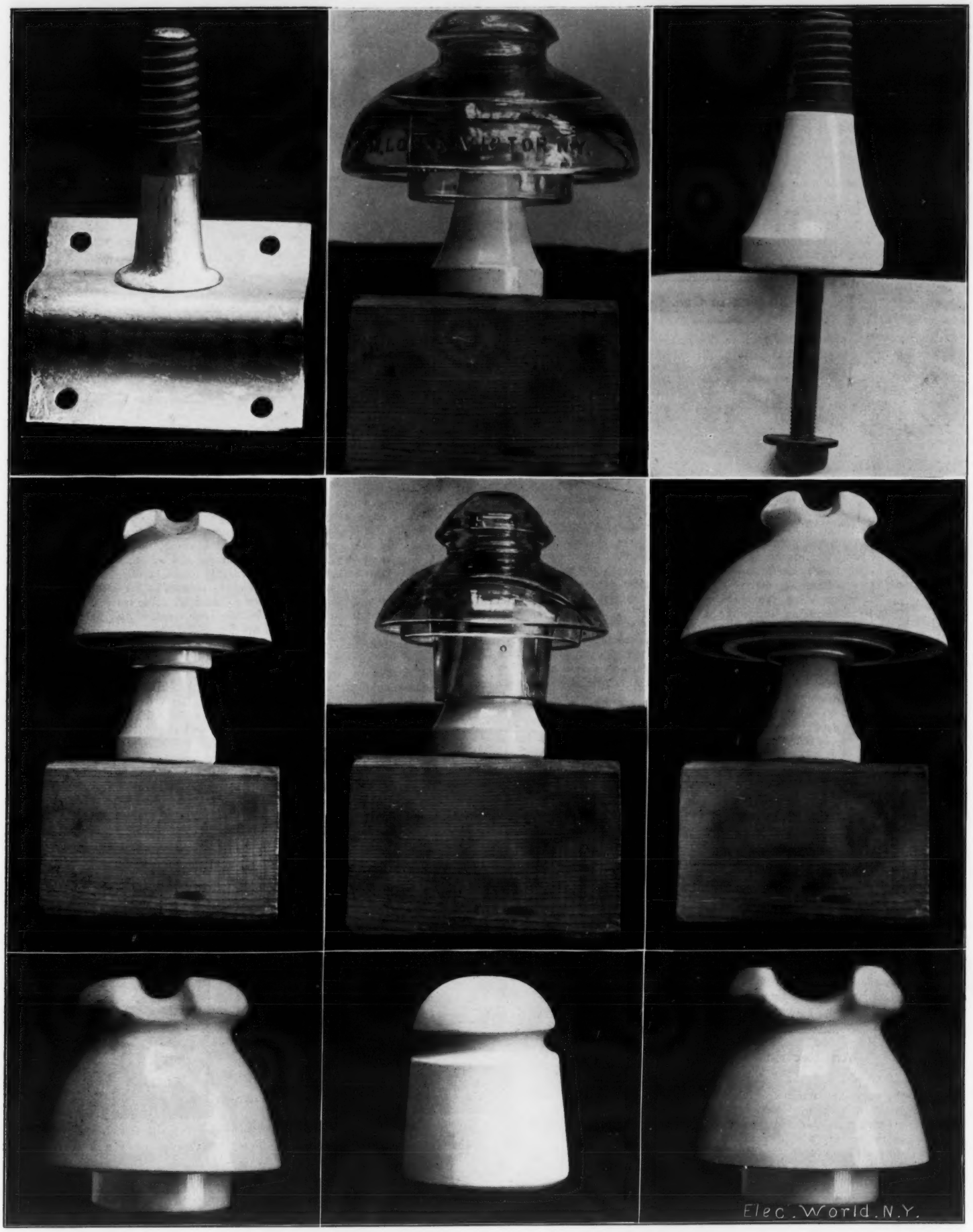


FIG. 1.—GALVANIZED-IRON SIDE BRACKET.
FIG. 2.—NO. 17, GLASS INSULATOR.
FIG. 3.—STEEL PIN WITH PORCELAIN BASE.
FIG. 4.—NO. 3, THREE-SHELL CHINA INSULATOR.
FIG. 5.—NO. 18, GLASS INSULATOR.
FIG. 6.—NO. 4, THREE-SHELL CHINA INSULATOR.
FIG. 7.—TWO-SHELL CHINA INSULATOR.
FIG. 8.—PONY CHINA INSULATOR.
FIG. 9.—TWO-SHELL CHINA RAILWAY FEEDER INSULATOR.

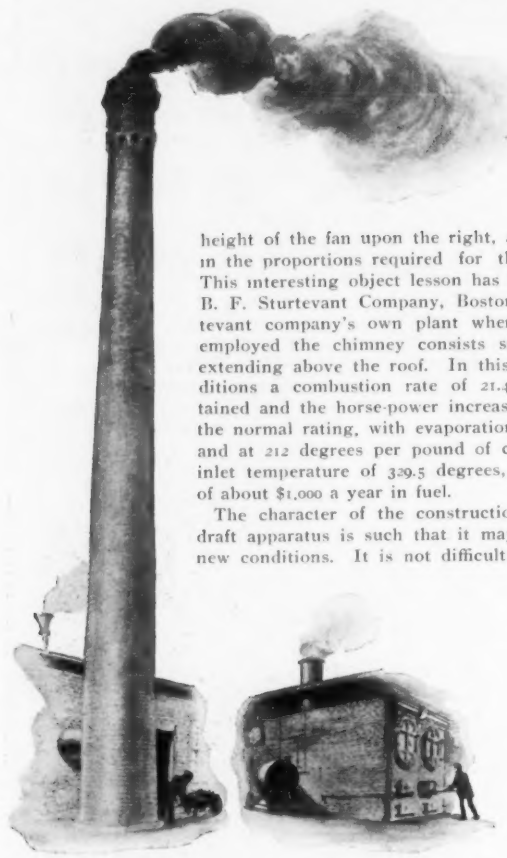
A Removable Fuse Holder.

Messrs. Zindars & Hunt, 127 Fifth Avenue, New York, are manufacturing a removable fuse holder which is rapidly growing in favor among engineers. It can be removed at pleasure from the circuit. In connection with suitable clips it constitutes a switch in which the fuse connections are made on the movable part. The fuse is attached directly to the switch blades and thus does away with the necessity of having separate fuse connections provided on the switch blocks. The two blades at one end are provided with pins which fit into appropriate slots in the clips and when so arranged the fuse holder can be operated in the same manner as an ordinary knife switch.

When the fuse melts from any cause the fuse holder can be lifted out and taken away to be re-fused, or, since the fuse holders are interchangeable, a previously fused holder can be substituted. Guards are placed over the fuse, and prevent the fused metal from reaching the hand should the fuse blow while the holder is being inserted on a bad circuit. These guards also prevent the fused metal from dropping on other fuses, and blowing them, as sometimes happens in panel board work where a precaution of this kind is not taken. While this fuse holder is primarily intended for use on panel boards, it can also be used for any other purpose for which a knife switch is ordinarily installed.

"Sixteen to One."

Familiar as this expression has been in the past, it is doubtful if it has ever been applied to the relation of the size of the chimney and the size of the fan required to produce a draft with the same boiler capacity. The accompanying illustration, which is drawn to scale, shows that the chimney on the left is about sixteen times the height of the fan upon the right, although they are both in the proportions required for the same boiler plant. This interesting object lesson has been developed by the B. F. Sturtevant Company, Boston, Mass. In the Sturtevant company's own plant where mechanical draft is employed the chimney consists simply of a smokepipe extending above the roof. In this plant under test conditions a combustion rate of 21.45 pounds was maintained and the horse-power increased 103 per cent. above the normal rating, with evaporation of 10.75 pounds from and at 212 degrees per pound of combustible, and a fan inlet temperature of 329.5 degrees, resulting in a saving of about $1,000 a year in fuel.



Before and After Mechanical Draft.

The character of the construction of the mechanical draft apparatus is such that it may be built to suit any new conditions. It is not difficult to substitute a larger apparatus for one that has been outgrown, and it is a very simple matter to install a forced-draft fan as an accessory to an existing chimney. Such an application, it is stated, may in some cases show an annual saving in fuel cost of from five to ten times the first cost of the fan installation, this saving, of course, being due to the substitution of a low-grade fuel which can be burned by the intense fan draft, but which could not be burned by the more sluggish draft in the chimney.

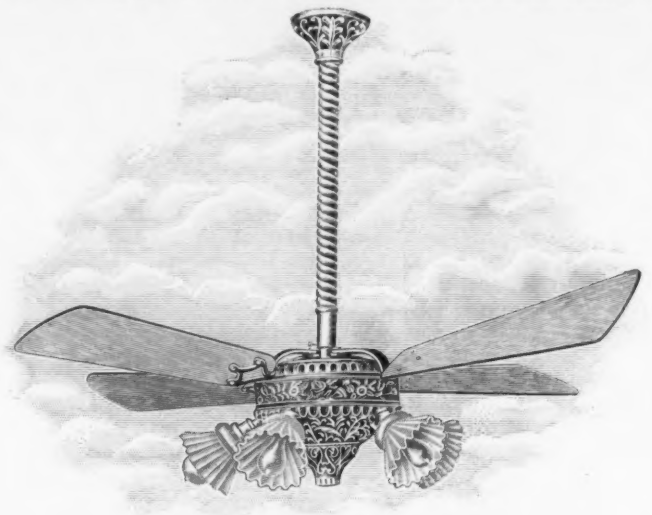
An Electric Fan of New Design.

One of the many new designs of electric fans brought out by Messrs. D. L. Bates & Brother, Dayton, Ohio, is illustrated in the next column. There is but one bearing in this fan, and that runs in oil. The bearing extends through the entire length of the motor, and will always keep its alignment, thus obviating all danger of the armature striking the pole pieces. The fan is provided with a switch, which is completely encased in the housing at the top of the motor casing, but accessible for operation. The illustration shows the fan with switch and electric-light attachment, but these may be dispensed with if desired. The general external finish of these machines is nickel, oxidized copper or polished brass, but they are also furnished in black enamel finish with polished brass trimmings.

The firm has also placed on the market a 12-inch and a 16-inch desk fan; also an adjustable bracket fan for 110, 220 and 500 volts direct current, the fields of which are made of forged steel. They are guaranteed to consume less current than any other fan of corresponding size. The firm also manufactures alternating ceiling fans and water-motor buzz fans, which, it is stated, give excellent satisfaction.

A New Circuit Breaker.

The instrument shown in the lower cut is the "Buffalo" expansion circuit breaker, which is being placed upon the market by Messrs. McCarthy Brothers & Ford, 45 North Division Street, Buffalo, N. Y. The breaker consists of an attachment placed on the ordinary knife switch, the complete instrument performing the functions of both knife switch and circuit breaker. The

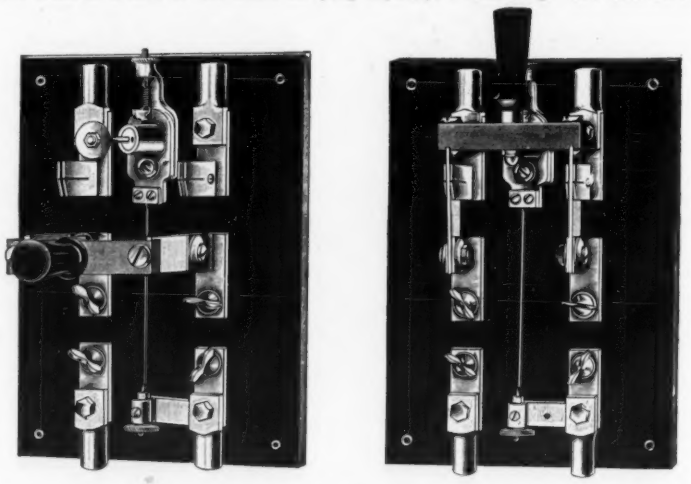


Ceiling Fan with Electric Lights.

switch may be used in the ordinary way without any reference whatever to the breaker attachment, thus obviating the necessity of a switch separate from the circuit breaker.

This breaker depends for its operation on the expansion of a metal rod, due to the heating effect of the current flowing through it. When the thermal rod expands under the heating effect of the current it actuates the tripping device, which holds the opening spring in a closed position, thus releasing the spring and throwing the switch. It is stated that the rod will open the switch before heating to such an extent as to be unbearable to the hand.

It is claimed that this breaker is in every respect as serviceable as magnetic circuit breakers, and that it is superior to them for some classes of work, especially for motors. In such applications the time element may be made as large or small as desired. The expansion breaker takes care of the first rush of current, or a continuous flowing current will open the circuit in five or ten seconds, or in one minute, according to the adjustment of the instrument. The switch is opened by means of an extremely strong spring operating in the centre of the connecting bar. This spring is held in a compressed position by a catch, the normal position of which is open, but which is held closed by the expansion rod. Any excess of current through the rod above its rated capacity will cause the wire to heat, and, in heating, will expand, allowing the catch to open, thus releasing the spring which throws the switch handle. It is stated that the wire will expand on less than 10 per cent. increase of current over the rated load, enough to allow the spring to act, and on a short circuit will operate instantaneously. The rod is made of special metal, whose resistance is about the same as a fuse of the same carrying capacity, 1 inch long. The instrument



Expansion Circuit Breaker with Switch in Open and Closed Positions.

can be used on either direct or alternating current of any voltage, and, as may be seen by a glance at the illustration, is extremely simple in construction. These expansion circuit breakers are furnished with fuse terminals as an extra precaution against accidental disablement of the breaker attachment. If anything should happen to the latter a set of ordinary fuses can be inserted in the circuit until necessary repairs are effected.

These breakers are made single, double or triple pole, single or double throw, with switches either single or double break. They are also provided with front or back connections, with or without carbon breaks, and are made in sizes ranging from 25 to 200 amperes capacity.

Financial Intelligence.

NEW SECURITIES LISTED.—The additional issue of $750,000 7 per cent. cumulative preferred stock of the Twin City Rapid Transit Company has been listed on the New York Stock Exchange.

THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK reports gross earnings for January, $334,451.25, an increase over January, 1898, of $36,143.89; net earnings, $164,811.27; increase, $16,922.05.

BIG ADVANCE IN THIRD AVENUE STOCK.—One of the features of the New York stock market last week was the remarkable increase in the price of the Third Avenue Railroad stock. The lowest quotation of the week was 191 and the closing price 238, showing a net increase of 46½ points.

THE NEW YORK GAS AND ELECTRIC LIGHT, HEAT & POWER COMPANY on February 21 gave a mortgage to the State Trust Company, trustee, for $15,000,000, payable in fifty-year 5 per cent. gold bonds. The mortgage covers the gas company's property in New York City and all its rights, privileges and franchises. The money raised will be used for the improvement of the company's property and to pay for the stock and bonds of corporations which have been recently absorbed. Seven thousand five hundred dollars in revenue stamps were affixed to the mortgage.

CONSOLIDATION OF ELECTRICAL INTERESTS IN BALTIMORE.—A Baltimore dispatch conveys the intelligence that Messrs. Alexander Brown & Sons on February 23 formed a syndicate to underwrite the securities of the United Electric & Power Company, a corporation which will take over the combined electric light companies of Baltimore, and which will shortly absorb the Home Telephone Company. There will be a total of $4,500,000 of 4½ per cent. bonds, of which $1,000,000 will be retained in the treasury for improvements and other requirements of the company. The amount of securities that will be taken by the syndicate will be $3,500,000 of 4½ per cent. bonds and $700,000 of 5 per cent. cumulative preferred stock.

THE PHILADELPHIA COMPANY.—Messrs. Brown Brothers & Co. are offering for subscription at 107½ $4,000,000 first mortgage and collateral trust fifty-year 5 per cent. gold bonds of the Philadelphia Company. They are a part of the total authorized issue of $6,500,000. The company has for many years supplied with natural gas the cities of Pittsburg and Allegheny, Pa., and many adjacent towns. It recently acquired control of the Allegheny County Light Company, and has contracted for the control of the Consolidated Illuminating Gas Company, of Pittsburg. It proposes by an increased issue of its common stock to secure the United Traction Company, of Pittsburg. The bonds are secured by a first mortgage on all of the properties of the Philadelphia Company and by the deposit of securities in companies controlled or contracted for.

Special Correspondence.

New York Notes.

LIGHTING ST. PAUL'S CATHEDRAL IN LONDON.—A London dispatch dated February 22 stated that Mr. J. Pierpont Morgan, the well-known banker of this city, had promised to contribute $25,000 toward the installation of an electric illuminating system in St. Paul's Cathedral, London.

OLD TROLLEY WIRE WORTH MORE THAN NEW.—The Brooklyn Heights Railroad Company is just now having a rather anomalous experience in the replacing of its worn-out trolley wire with new. It is getting more money for its old wire as old copper than it is paying for the new wire. This, it is said, is due to the fact that the company executed a contract last year which provides for the delivery throughout the present year of new wire, and at prices in accordance with the market at the time the contract was signed. The price of copper has gone up since then, so that the copper company, it is said, will lose many thousands of dollars.

ELECTRICITY ON THE MANHATTAN "L."—President George Gould, of the Manhattan Railway Company, on February 20 sent to the stockholders a statement with reference to the proposed introduction of electric power on the lines of the company. The facts contained therein are substantially the same as those given in an article on the subject in THE ELECTRICAL WORLD of February 11. In the letter Mr. Gould states that the president and directors of the company are of the opinion that the change and consequent improvements ought to be made, and therefore recommends the stockholders to give it their sanction. The stockholders will be given the right of taking new stock at par on a basis of 60 per cent. of their holdings, concerning which further communication will be made to the stockholders after their meeting of February 28.

A NEW ELECTRIC VEHICLE COMPANY.—The New York Electric Vehicle Transportation Company was incorporated at Trenton, N. J., on February 23, for the purpose of manufacturing and selling vehicles of all kinds to be operated by electricity, compressed air, gas, oil or other means of motive power; also to acquire franchises for the operating of these vehicles to carry passengers and freight of all kinds. Mr. Augustus Treadwell, of the New York office of the Electric Storage Battery Company, is one of the incorporators. It is stated that the Electric Storage Battery Company is behind the new concern. Mr. Isaac L. Rice, president of the Electric Storage Battery Company, is reported to have said that the new company is an enlargement of the established Electric Vehicle Company, which has been operating electric cabs in this city for some time. He denied that the company had been organized in opposition to the Auto-Truck Company, headed by Mr. Richard Croker. The authorized capital of the new company is $25,000,000.

WAR TAX ON MORTGAGES.—Two warrants in distraint have been issued in Brooklyn Borough directly against the Edison Electric Illuminating Company and the Kings County Electric Light & Power Company, with a view to compelling the payment of $10,000 as revenue taxes on two mortgages for $10,000,000 each, issued by these companies last November. When the mortgages were recorded they bore stamps for $999.50 for the $2,000,000 representing the bonds actually issued, but the companies were informed that this tax was not enough, and that they would have to pay on the entire $20,000,000. The subject was given consideration by Commissioner Scott, who decided that the companies would have to pay a tax on the entire bond issue. The deputies, who met with no resistance at the office of the Edison company, took away the money contents of the safe, amounting to $4242. They then went to the office of the Kings County Company, where they had a similar experience. The result of this action, it is thought, will be a suit against Internal Revenue Collector Moore, who issued the warrants.

AMENDMENT TO THE RAPID TRANSIT LAW.—On February 22 the amended New York City rapid transit law was introduced in both Houses of the Legislature. The amendments were prepared by the Rapid Transit Commissioners, as mentioned in THE ELECTRICAL WORLD of February 4. Section 1 of the existing law is modified to include cities which shall in the future have a population of 1,000,000 inhabitants, as well as those which have at the time of the enactment of the latter. Section 6 is amended so as to provide that the Rapid Transit Commissioners, in preparing detailed plans and specifications for the construction of a rapid transit railway, shall include provisions for subways or tunnels for sewer, gas or water pipes, electric wires and other conductors suitable to be placed underground, whenever necessary so to do, and also such provisions as may be necessary for reconstruction or readjustment of sewer, water or other pipes or structures beneath streets of the route or other streets. All such provisions shall be deemed to be incidental to and part of such construction of such railway; and the cost of carrying out all such provisions shall be deemed part of the cost of such construction. Stations and station approaches may be over or under, or some over and some under streets of the route or cross streets. It is also provided that the company constructing the road shall bear all expense of reconstructing sewer and other pipes and of restoring the surface of the street to its proper condition. Such subways for sewer or other pipes are to be maintained by the city, and not by the railway company. The section is further amended so as to give the Board of Rapid Transit Commissioners power to grant to the contractor constructing a rapid transit road the right to the control of pipes, ways or conduits necessarily used in connection with the operation of such railway. That part of section 7 which provides that the Board of Rapid Transit Railroad Commissioners shall sell at public auction the right to construct and operate a rapid-transit railroad is stricken out, and the following provision is substituted: "The said board shall, with due diligence, construct the said railway or railways, or cause the same to be constructed in one of the three following methods—that is to say, either, first, by the city as in section 34 of this act provided; or, if the said board shall deem construction by the city to be impracticable, for any reason which, in the opinion of the said board, shall be sufficient, then, in its discretion, either, secondly, by a contract with any railroad company then owning or actually operating a railroad within the city, such contract to be made between the said board and said railroad company, as prescribed in section 32 of this act; or, thirdly, by a grant to a railroad company then owning or actually operating a railroad within the city, or a corporation to be formed under the provisions of this act, of the franchise to construct and operate the railroad, as in this section hereinafter provided. Every consent to the construction or operation of any such railway or to its routes or general plan of construction which shall have been given by any municipal authority or by any person or by the Appellate Division of the Supreme Court, or by any commissioners thereby appointed, shall be deemed sufficient for either of the said methods, whether, at the time such consent shall have been given, such method or any other method of construction shall or shall not have been prescribed or contemplated. If the said board shall approve such third method, then it shall make and deliver, in behalf of the city for which it acts and for the account and benefit of such city, a grant of the right, privilege and franchise to construct, maintain and operate such railway or railways. Such grant shall be made after the sale of such right, privilege and franchise at public auction and pursuant to, and shall include the text of the terms of sale to be prescribed as hereinafter provided; and the said grant shall be made to the bidder whose bid shall be accepted as hereinafter provided. Such grant shall be made with the concurrence of six members of the said board." * * * It is also provided in an amendment to section 32 that the Board of Rapid Transit Railroad Commissioners may, by the concurrent vote of six of its eight members "grant the right and franchise to construct and operate such rapid transit railway or railways to any railroad corporation owning or actually operating a railroad within the said city, and (if such city be divided into boroughs) in the borough or boroughs thereof in which such rapid transit railway or railways shall have been laid out, whether the said rapid transit railway or railways and the railroads so owned or actually operated shall both be underground, surface or elevated railroads."

New England Note.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—A teachers' reception was given last week in the new Pierce Building, on Trinity Place. Invitations were sent to the school principals and superintendents, institute graduates teaching in Massachusetts and members of teachers' associations in physics, chemistry, and biology. The guests were received by members of the corporation and faculty. Lunch was followed by an address by President Crafts.

Philadelphia Notes.

CHANGE OF NAME.—The name of the Philadelphia Motor Wagon Company has been changed to the Pennsylvania Electric Vehicle Company, and the stock has been increased from three to six million dollars. The company is authorized to make and deal in self-propelled vehicles. The incorporators are Cornelius W. Woodward and William J. Jackson, of Philadelphia, and Josiah S. Dubois, of Camden.

A NEW TELEPHONE BUILDING.—The Bell Telephone Company has planned to erect in this city a new building at the northwestern corner of Seventeenth and Filbert Streets. It is to be eight stories high, with an attic, and of iron and steel skeleton frame construction. It will have a frontage on Seventeenth Street of 117 feet 2 inches, and on Filbert and Cuthbert Streets of 58 feet 2 inches. It will be 114 feet 3 inches high, and the walls will be constructed of granite, brick and terra cotta. Work on its erection will be commenced in a few weeks.

Buffalo and Niagara Falls Notes.

THE BUFFALO, TONAWANDA & NIAGARA FALLS ELECTRIC RAILWAY has adopted Niagara power, and will be operating with it in a few days. The connecting line between the railway power station and the transmission line of the Cataract Power & Conduit Company is now complete.

PAN AMERICAN EXPOSITION.—The subscriptions to capital stock have reached $1,347,160, only a very small portion of which has been raised outside of Buffalo. The canvass for outside subscriptions is just being taken up. The Congressional committee is now in Washington. At Albany a bill for a State exhibit, carrying $300,000, is progressing without opposition. The matter of a site is under consideration, but no action can be taken till the incorporators elect a board of directors to take up the affairs of administration.

THE ACHESON GRAPHITE COMPANY has been incorporated with capital stock of $1,000,000 for the manufacture of carbon from a by-product of the Carborundum Works. The factory will be located on the lands of the Niagara Falls Power Company, and will use about 500 e. h. p. to begin with. Mr. E. G. Acheson, of Buffalo, is president of the company, and has taken out the patents under which the factory will operate. Mr. C. R. Huntley, of Buffalo, is vice-president and treasurer. Mr. P. M. Bennie, of Washington, D. C., is secretary.

TROUBLES WITH ICE AT NIAGARA FALLS.—The hydraulic power companies at Niagara Falls have got through the winter without serious trouble with ice till during the past week, when at the end of a spell of extremely cold weather high winds broke up the ice at the easterly end of Lake Erie and sent large quantities down the Niagara river. An ice jam formed in the shallows above the rapids, near the end of the Niagara Falls Power Company's canal, and for about twenty minutes largely cut down the supply of water, so that the whole station was shut down for several minutes till the jam could be broken up, when service proceeded as before. The Hydraulic Power & Manufacturing Company has had more serious trouble. The ice jam above the falls cut off the water from the head race canal, and the ice jam in the gorge below the falls blocked the outlet from the wheels. One wheel after another was shut off as the water failed, the "Gorge Road" wheel being the last to stop. The weather was extremely cold and ice formed in the penstocks. Several days were required to clear away the ice, but the plant was put in operation again on February 18.

RECEIVERSHIP FOR THE "GORGE ROAD" (Niagara Falls & Lewiston R. R.)—Early in February the control of the Niagara Falls & Lewiston Railroad was sold to New York parties, and Mr. J. R. Megrue, of New York, was elected president, succeeding J. M. Brinker, of Buffalo, who built the road. After a careful examination of the affairs of the company it became evident that the mode of operation must be thoroughly reorganized, and that a considerable expenditure will be needed for repairs and improvments, for which bonds must be issued. The road has done a fair amount of business, carrying over 240,000 passengers during the past year. The expenses of operation and maintenance are large, and the management has not been economical. On the petition of the directors Mr. Megrue has been appointed receiver for the property, and has opened an office in Erie County Bank Building, Buffalo. Messrs. Mott, Sprague, Brownell and Marcey are counsel for receiver, and Mr. Geo. A. Ricker is engineer. The operation of the road was stopped on February 14 owing to the shutting down of the Niagara Falls Hydraulic & Manufacturing Company, who furnish power, and will be resumed in the Spring, after the road has been thoroughly overhauled and put in first-class condition.

Indiana Notes.

ELECTRIC RAILWAY FRANCHISE GRANTED.—The Cambridge City Interurban Electric Street Car Company has secured a long-sought-for franchise from the Cambridge City authorities, and will at once construct and operate a line to Hagerstown, Dublin, Germantown and Milton.

TELEGRAPH RATE BILL DEFEATED.—A bill in the Legislature cutting down the rates of a common message of ten words to 20 cents instead of 25 cents, and providing that the day press rate should be fixed at one-third of a cent and the night press rate at one-sixth of a cent a word, was defeated by a vote of 24 to 23.

ANOTHER ELECTRIC RAILWAY FRANCHISE is sought in Morgan County by Indianapolis capitalists. The proposed route is almost parallel with the Indianapolis & Vincennes railway from Martinsville south. The stipulation is that the fare shall be one-half the regular railroad rate. Other parties are asking for franchises through this county.

ELECTRIC RIGHT OF WAY BILL KILLED.—A bill prohibiting county commissioners from granting to electric or other railroad companies the right to construct railroads on the public highways has been killed by a vote of 61 to 25. The author of the bill said it simply left the right with the landowners, where it belonged, to say whether or not a railroad should have a franchise to operate over roads on which their lands abut. The opposers said the bill was absolutely prohibitory; that a few stubborn land owners could put a stop to the progress which promises to thread Indiana with electric railways.

ELECTRIC LIGHT FRANCHISE.—The Board of Public Works at Indianapolis signed and granted a franchise to the Chenowith Light & Power Company on February 20. The franchise confines the company's operation to a strictly defined part of the city. After 20 years the city shall have the right to buy the company's plant. The company must pay to the city 5 per cent. of its gross receipts and make a detailed statement twice a year. Five householders in a square of said territory may petition for service, and if granted by the Board of Works the company must supply the service or forfeit $10 to the city for each day until it obeys the order. Competition between this company and the Indianapolis Light & Power Company is depended on to regulate the rate.

THE CENTRAL UNION'S BIG MORTGAGE.—The Central Union Telephone Company executed and filed for record in Marion County (Indianapolis) a $6,000,000 mortgage on the property of the company to secure that amount of gold bearing bonds dated January 2, 1899. It was filed practically at the same hour in sixty-nine other counties where the company has part of its property. The war revenue charge for recording the mortgage was $3,000. There were sixty $50 stamps attached to the original mortgage. The mortgage is on the franchise, poles, wires, plants and lands of the company in Indiana, and is given to the Old Colony Trust Company, of Boston. It is signed by Wm. A. Jackson and W. S. Chapman, president and secretary respectively of the telephone company, and by Gordon Abbott and E. A. Phippen, vice-president and secretary respectively of the trust company.

Chicago Notes.

THE STREET-RAILWAY FRANCHISE MATTER.—The special committee of the Council Committee which has been considering the various street-car extension ordinances has reported in favor of postponing all action on franchise extension until after the Legislature has repealed the Allen law and substituted something else in its place.

"THE ELECTRICAL BUSINESS" was the subject of an open discussion before the Y. M. C. A. Electrical Club on the evening of February 24, at the association parlors, 153 La Salle Street. The questions considered with reference to the electrical business were: Does it pay? Where are the chances? How to get a start. When to keep out. Which pays the best, the technical or the business branches? Mr. George A. Damon is the director of the club.

INDEPENDENT TELEPHONE FRANCHISE.—The ordinance concerning the Illinois Telephone & Telegraph Company, which was amended to meet the views of Mayor Harrison, was passed by the City Council on February 20. It grants the company a thirty-year franchise and permits it to charge $85 a year for business telephones and $50 for residences. At any time it sees fit to do so, the City Council may order a reduction in the rates, this provision being in lieu of any compensation to the city for the franchise other than furnishing a certain number of telephones free of charge. The principal promoters of this company are Adolph Busch and W. J. Lemp, of St. Louis; H. A. Everett, of Cleveland, and others. In this correspondence in the last issue of The Electrical World other facts regarding this enterprise were published.

St. Louis Notes.

THE BROADWAY CABLE LINE.—A meeting of all the minority stockholders of the Broadway Cable Line will be held in a few days, and if an agreement can be reached to sell their stock for cash or exchange it for stock in a new company, which proposes to absorb all the lines of the Hamilton Syndicate, a change will be made to electricity in the motive power of the road.

A SUIT FOR INFRINGEMENT of patent was brought a few days ago in the United States Circuit Court against the Imperial Electric Light, Heat & Power Company. It was brought by the Edison Electric Light Company, of New York, and its licensee, the Missouri-Edison Electrical Company, against the Imperial company and J. F. Campion, the president, and E. G. Bruckman, the secretary. It involves the system of electrical distribution employed by both the Missouri-Edison and the Imperial companies. An injunction was also asked restraining the company from continuing to use the system.

THE STREET RAILWAY DEALS.—It is stated that the street railway lines of St. Louis recently acquired by Messrs. Brown Brothers, of New York, will be united in a consolidation having about $80,000,000 capital. There will be a bond issue for $40,000,000 of 4 per cent. general mortgage bonds, of which about $22,000,000 will be employed in the purchase and $18,000,000 reserved to retire outstanding bonds of the various roads as they fall due. The present bonds amount to $18,000,000, bearing interest at 5 or 6 per cent. About $3,000,000 of the old bonds fall due in 1900. Refunding will effect some saving, and a large saving will be brought about in operating costs. The new company will be known as the Union Depot Railway Company System.

Pacific Coast Notes.

RED BLUFF'S BURNED ELECTRIC POWER PLANT.—There was but little insurance on the electric power station recently destroyed by fire in Red Bluff, Cal. The system was installed last fall by James Cross at a cost of $25,000.

THE ELECTRICAL ENGINEERING COMPANY, San Francisco, has moved into a new three-story brick factory and office building at 509 Howard

Street. Motors, generators and electric elevators are manufactured by the company.

POLICE TELEGRAPH SYSTEM FOR STOCKTON.—The city of Stockton, Cal., has been making inquiries as to the cost of a police telegraph system of sufficient capacity for the needs of that city. Probably about 20 boxes will be required.

TO THE GRAND CANYON IN AUTOMOBILES.—Officials of the Santa Fe Railroad recently signed contracts, in Los Angeles, Cal., for ten automobile carriages, which are to be used between Flagstaff, Arizona, and the Grand Canyon of the Colorado. Sixteen miles an hour is the required speed.

EXTENSION OF THE BLUE LAKES TRANSMISSION LINE.—The Standard Electric Company, of California, Mr. C. P. Gilbert, manager, is pushing construction work upon the pole line extension from Blue Lakes City, Cal., to Stockton. April 1 is the date fixed for the completion of this high voltage transmission line.

CANADIAN NOTES.

ELECTRIC VEHICLES IN TORONTO.—During the past week a number of electric carriages and cabs have been objects of much interest on the streets of Toronto. Storage batteries furnish the motive power, and each carriage has sufficient power to make a trip of 30 miles. Several wealthy Toronto business men are interested in developing the enterprise in that city, and many carriages will soon be in operation there.

THE OTTAWA ELECTRIC COMPANY has begun extensive improvements in its power plant at the Chaudiere Falls. New buildings and heavy machinery will be added. A new flume will also be built, which will be 20 feet wide and will be closed in on one side by a cut of solid rock and on the other by an immense stone wall. It is expected that by the company's method of controlling the water flowing into the flume anchor ice will be avoided.

THE SHAWINIGAN WATER-POWER PLANT.—An important real estate deal has been put through by the Shawinigan Water & Power Company, of Montreal, which will enable the company to go ahead with the development of the power at that place. Contracts for the work of developing the water power will soon be given out by the company. The proposed development of this power was described and illustrated in THE ELECTRICAL WORLD of February 18 last.

A NOVA SCOTIA TRANSMISSION LINE.—The Bedford Electric Company, of Halifax, N. S., proposes to install an electric plant at St. Margaret's Bay to transmit electricity for light and power to Halifax and other points, and to furnish power for the operation of an extensive pulp mill to be erected. The transmission line will be 18 miles in length, and the pipe line from the power house to the dam about 4000 in length. It is also proposed to operate an electric tramway to Halifax.

ELECTRIC WIRES AND STREET RAILS AS REAL ESTATE.—A deputation representing several of the cities of the province has waited on the Ontario Government asking that the law be changed so that wires, rails, tracks and other property of street railway, telephone, electric light and power, telegraph and such other companies should be classed as real estate, and the basis of value thereof should be the same as any real estate owned by a private individual. Street cars to be assessed as personalty.

THE CANADIAN GENERAL ELECTRIC COMPANY has been awarded by the Department of Railways and Canals the contract for the erection of a power house and the complete equipment of the Soulanges Canal with electrical apparatus, for operating the locks, by means of electric motors. The entire canal, covering a distance of 14 miles, will be illuminated by arc lamps. Owing to the success met with in the operation by electricity at the canal at Sault Ste. Marie, Ont., as applied to the locks, the department decided to make a more extensive application of its use in the illumination and electrical operation of the locks of the Soulanges Canal.

WATER POWERS IN THE OTTAWA VALLEY.—Mr. Andrew Holland, of Ottawa, has prepared an estimate of the various water powers in the Ottawa Valley. His calculation is as follows: Ottawa River, 664,000 horse-power; Rideau River, 1300 horse-power; Mississippi River, 14,700 horse-power; Madawaska River, 20,600 horse-power; Bonnechere River, 3400 horse-power; Petit Nation, 2000 horse-power; Blanche River, 2000 horse-power; Lievres River, 98,450 horse-power; Little Blanche, 300 horse-power; Quyon River, 100 horse-power; Coulonge River, 27,600 horse-power; Black River, 24,000 horse-power; Gatineau River, 31,675 horse-power, making a total of 890,225 horse-power.

ENGLISH NOTES.

THE NERNST INCANDESCENT LAMP.—The scientific world recently had an opportunity, for the first time, of examining some of Dr. Nernst's new incandescent lamps, for which an efficiency of 1-1½ watts per candle is claimed, with a reasonable life and cheap cost of renewal. It will be remembered that the lamp consists essentially of a rod of magnesia or a mixture of similar highly refractory oxides, which, although an insulator at ordinary temperatures, becomes an electrolyte when raised to incandescent heat. The rod has first to be heated by external means, and then the passage of the current keeps it at the requisite temperature. Several methods of initial heating have been devised. For the small lamps a match even suffices, while for the larger ones a spirit lamp or a heated platinum spiral must be used. The latter arrangement, which is of course preferable wherever the lamps have to light automatically, is so arranged that before the lamp is alight the spiral encircles the magnesia rod, but immediately the current passes through the rod the spiral is automatically lifted away from it and its circuit is broken. The exhibition of these lamps took place at the Society of Arts on the occasion of a paper read by Mr. James Swinburne. He stated that the first lamp to be put on the market will probably be one corresponding to the larger sized incandescent lamps, and it appears that even if the Nernst lamp does not replace the carbon filament lamp generally this size of Nernst lamp suitable for street lighting will have a great future before it. Although less efficient than an arc lamp when the efficiency is stated in watts per candle, it will probably be found much more suitable and economical for outside illumination. It will also prove to be a serious competitor to the Welsbach incandescent gas lamp. The lamps are stated to be equally suitable for alternating and continuous currents when the rod glows in air, and the life of the rods is said to be about 400 hours.

WIRING RULES.—The Institution of Electrical Engineers has spent two evenings in discussing three papers by Messrs. Crompton, Wordingham and Pigg on rules for the regulation of wiring to be connected to public supply mains. The Institution of Electrical Engineers issued eighteen months ago a set of admirable wiring rules with a view of their replacing the numerous codes already in existence. This move appears to have been quite unsuccessful, however, as all the insurance companies continue to enforce rules of their own, they having some five or six sets between them, differing considerably in detail. Central station engineers also, especially those connected with municipal electric supply undertakings, have issued wiring rules differing considerably from one another. Mr. Wordingham, who is the electrical engineer in charge of the Manchester municipal electric lighting station, one of the largest provincial stations in the United Kingdom, although he was a member of the committee which framed the Institution rules above referred to, and in his paper advocates uniformity, has recently issued a number of quite revolutionary rules for the control of wiring work in Manchester. In them he stipulates that no fittings of any sort are to be used unless they have been certified as suitable at his own office. The inconsistency of this was referred to by many of those who took part in the discussion. At the close of the discussion the following resolution was passed, viz.: "That this meeting is of the opinion that the Institution should take such steps as it thinks best to secure uniformity of rules, by pressing on supply companies, municipal engineers and fire offices the advantage of adopting some rules to be drawn up by the Institution, based on the present ones as a standard, with such modifications only as local conditions may necessitate." It is to be regretted that the Institution of Electrical Engineers has found such difficulty in coming to an agreement with the various parties who are interested in enforcing wiring rules, for it is high time that we should have a code corresponding to the "National Electrical Code" in force in the States. The resolution does not go nearly far enough, but at any rate the general feeling on the question, now that it has once more been raised, is so strong that the Council of the Institution of Electrical Engineers will be forced into greater activity than hitherto.

A CHANGE IN THE ARTICLES OF ASSOCIATION OF THE INSTITUTION OF ELECTRICAL ENGINEERS.—Towards the end of last year a change was made in the Articles of Association of the Institution of Electrical Engineers, a new class of associate members being created between that of members and associates. The associate member is to have the privilege of adding A. M. I. E. E. after his name instead of the A. I. E. E. of the associate, and of paying higher fees. In other respects, such as in his voting power, he has no advantage over the associate. However, the qualifications required for admission to this new class are fairly high, in fact they almost correspond to those which have hitherto been demanded for full membership of the Institution. The rule reads as follows: "Every associate member shall be either an electrical engineer or an electrician, and shall be at least 25 years of age, and whether admitted by election or by transfer, shall come within one of the following descriptions: (a) He shall have been on the register as an associate on December 31, 1898, or (b) he shall have been educated as an electrical engineer or electrician in a manner which shall satisfy the Council, and either (1) shall have had subsequent employment for at least two years in a responsible situation as an electrical engineer or electrician and shall be actually engaged in such a situation at the time of his application for election or transfer; (2) he shall have been engaged for at least five years in one of the branches of electrical engineering and shall be actually so engaged at the time of his application, and shall afford satisfactory proof to the Council of his fitness for election; or (3) being an associate he shall have gained a premium in any year for a paper read at an ordinary general meeting of the Institution." The standard for members has been raised to the following: (a) He shall have been educated as an electrical engineer or electrician in a manner which shall satisfy the Council, and either (1) shall have had subsequent employment in the application of electricity for at least five years in situations of superior responsibility and shall be actually engaged in such a situation at the time of his application for transfer or election or (2) shall be in practice and shall always have practiced on his own account in the profession of an electrical engineer or electrician for at least five years and shall have acquired sufficient eminence in the same or, (b), being either in a position of superior responsibility or in practice on his own account in the profession of an electrical engineer or electrician he shall have held such responsible position or positions or shall have so practiced on his own account that he has acquired sufficient eminence in the said profession during a period or periods which singly or in the aggregate shall amount to seven years, or (c) being an associate member he shall have gained the senior premium in any year for a paper read at an ordinary general meeting of the Institution, or (d) he shall be so prominently associated with the objects of the Institution that the Council consider his admission to membership would conduce to its interests." The new rules came into force on the 1st of January, and no less than 400 applications for transfer of associates into the class of associate members have already been sent in. Of these only 284 have been transferred to the new class. In addition to this there have been a considerable number of associate members newly elected. When it is considered that the whole number of associates in the Institution was only about 2,000 it is seen that the proportion of transfers is very large. The roll of the Institution numbered as follows at the end of July last year: Foreign members, 177; members, 654; associates, 1,863; students, 234, and 2 honorary members. A third honorary member was elected immediately the new articles of association came into force, in the person of Lord Kelvin. By the old rules honorary members could only be persons of distinction who were not members of the profession, but in the new rules the latter proviso has been omitted, and the Council have lost no time in conferring this honor on the greatest of living electricians.

General News.

New Incorporations.

THE DUPAGE COUNTY TELEPHONE COMPANY, Wheaton, Ill., has been formed by Margaret I. Isgrig, Henry M. Fisk and Frank Seward. Capital stock, $10,000.

THE CALLENDER POWER COMPANY, Stockbridge, Mass., has been formed by Charles E. Callender, John S. Fuller and Frederick S. Aymar, with a capital stock of $5000.

THE BOURBON WATER & LIGHT COMPANY, Bourbon, Ind., has been incorporated by C. M. Leekman, John C. Dales and C. C. Layton, with a capital stock of $11,000.

THE HOWARD TELEPHONE COMPANY, of Howard, Minn., has been incorporated by J. J. Martin, C. L. Olsen, E. E. Davoll, Charles E. Misard and W. P. Moore, with a capital stock of $2000.

THE FORDSVILLE & HARRISON TELEPHONE COMPANY, Frankfort, Ky., has been formed, with a capital stock of $1000. The incorporators are Edward W. Ford, P. C. Cooper and J. F. Smith.

THE WINTHROP GAS & ELECTRIC COMPANY, Winthrop, Mass., has been incorporated, with a capital stock of $100,000. The incorporators are Simon J. Donovan, Willard Massey and John W. Cawley.

THE CHENOWITH LIGHT & POWER COMPANY, Indianapolis, Ind., has been formed with a capital stock of $40,000. Among those interested are Van A. Chenowith, David D. Smith and Anthony H. Hannon.

THE MERCHANTS' LIGHT & POWER COMPANY, Harrisonburg, Va., has been incorporated, with a capital stock of $10,000. The incorporators are J. R. Green, H. L. Bushong, C. F. Thomason, E. B. Cootes and I. S. McNeill.

THE HUMBOLDT ELECTRIC LIGHT & POWER COMPANY, Humboldt, Ia., has been formed with a capital stock of $10,000. The incorporators are Ira L. Welch, W. W. Sterns, T. G. White, H. McKinstry, A. J. Ashby, E. K. Winne and D. A. DeGroote.

THE EAST KENTUCKY TELEPHONE & TELEGRAPH COMPANY, Carlisle, Ky., has been incorporated, with a capital stock of $1000. The incorporators are D. G. W. Evans, Richmond; F. H. Adair, F. B. Lindsay, C. T. Donnell, H. R. Ewing and others.

THE UNION ELECTRIC COMPANY, Cazenovia, N. Y., has been incorporated, with a capital stock of $25,000. The incorporators are David O'Connell, Marathon; John O'Donnell, Cazenovia; Thomas O'Connell, N. S. Miller and James Dougherty, Cortland, N. Y.

THE LANSING, DEXTER & ANN ARBOR RAILROAD COMPANY, Lansing, Mich., has been incorporated to construct and operate an electric street railway. The incorporators are Rush J. Shank, C. P. Black, C. A. Mapes and R. A. Montgomery. Capital stock, $250,000.

THE MILLER ELECTRICAL MAINTENANCE COMPANY, Camden, N. J., has been incorporated with a capital stock of $100,000. The incorporators are J. J. Miller, Charles E. Schmunk, Pittsburg; James R. Baird, Allegheny; W. C. Thomas, Pittsburg; William Bader, Allegheny.

THE ATLANTIC MANUFACTURING COMPANY, Waterville, Me., has been incorporated, with a capital stock of $1,000,000, for the purpose of manufacturing electrical apparatus. The incorporators are Charles E. Bibber and Herbert W. Smith, Boston, Mass., and Cyrus W. Davis, Waterville, Me.

THE MIDDLEPORT POWER COMPANY, Middleport, N. Y., has been incorporated with a capital stock of $15,000. The directors of the new company are Frank G. Scott and Thomas J. Wilcox, Niagara Falls; William J. Sterritt and George F. Thompson, of Middleport, and B. C. Stanton, of Sanborn.

THE MT. PLEASANT, SCOTTDALE & CONNELLSVILLE ELECTRIC RAILWAY COMPANY, McKeesport, Pa., has been incorporated with a capital stock of $400,000. The officers of the new company are: W. E. Tustin, president; G. S. Lewis, secretary; H. C. Fehl, treasurer; W. W. Staub, general manager.

THE AMERICAN CAR & FOUNDRY COMPANY has been incorporated at Trenton, N. J., with a capital stock of $60,000,000, for the purpose of manufacturing freight, passenger and street cars, trucks and car equipments. The incorporators are Adrian H. Larkin, F. L. Patton, Jr., and William H. Fain, all of Jersey City.

THE LEXINGTON RAILWAY COMPANY, Lexington, Ky., has been formed to operate street railway lines and furnish light, heat, power, gas and electricity. The incorporators are John T. Shelby, John R. Allen, R. P. Stoll, C. H. Stoll, J. C. Rogers, W. J. Loughridge, and C. J. Bronston. The authorized capital is $800,000.

THE ALTON RAILWAY & POWER COMPANY, Alton, Ill., has been formed, with a capital stock of $100,000, the object of the company being to maintain electric railways between points in Madison and St. Clair counties and to supply electricity, water and gas for heat, power, light and domestic and manufacturing purposes.

THE COMMERCIAL CABLE COMPANY OF CUBA has been incorporated in New Jersey, for the purpose of constructing and operating an electric telegraph between Cuba and the United States. The incorporators are C. H. Mackay, G. G. Ward, A. B. Chandler, E. C. Platt, G. W. Clapperton, A. Beck and W. W. Cook. Capital stock, $500,000.

THE CONSTABLEVILLE & WEST LEYDEN TELEPHONE COMPANY, of West Leyden, N. Y., has been incorporated to operate a telephone system connecting Rome, Martinsburg, Houseville, Constableville, Mohawk Hill, West Leyden, West Branch, Boonville and Highmarket. The directors are Benedict Cautler, S. C. Capron and I. Capron, Leyden; Frederick Myers and Elizabeth Myers, West Leyden, and J. J. Daunder, of Lewis. Capital stock, $3500.

The Telegraph and Telephone.

FERGUS, MINN.—The Fergus Telephone Company will extend its line to Armor, Me., and Phelps, a distance of about 20 miles.

FRANKLINVILLE, N. Y.—Mr. Virgil Hayden is to establish a telephone exchange here, which will be connected with outside towns.

ROCHESTER, N. Y.—The Home Telephone Company, of this city, has applied for a franchise to conduct a telephone business here.

OMAHA, NEB.—The Nebraska Telephone Company has completed arrangements to make several extensions of its line, involving an expenditure of about $275,000.

SALEM, MASS.—The People's Telephone Company has petitioned the Board of Aldermen for permission to conduct business in this city. A hearing will be given on March 8.

FONDA, IA.—A franchise has been granted to a local telephone company to establish an exchange in this place. It is expected to have the system in operation in sixty days.

CARLINVILLE, ILL.—The Carlinville Telephone Company has been absorbed by the Bell Company. The plant will be re-equipped and furnished with long-distance instruments.

BATH, N. Y.—The telephone rates of this city are to be reduced from $36 for business instruments and $30 for residences to $24 and $12 respectively. A new line is to be run to Wayland.

HARTFORD, CONN.—A bill has been introduced in the Legislature providing that telegraph and telephone companies shall receive dispatches from any person and for other telegraph or telephone lines and to transmit and deliver them in all places having a free delivery system, on the payment of the usual charges.

PITTSBURG, PA.—The Committee on Corporations of Pittsburg Councils has recommended the passage of the ordinance granting the Pittsburg & Allegheny Telephone Company the right to construct a line in the city. The company must establish a central exchange with which its lines must be connected, as they are constructed, at the rate of 12000 phones a year for three years.

UPPER SANDUSKY, OHIO.—The telephone war here is assuming large proportions. The Home Company, which has been in operation for nearly five years, has over 200 instruments outstanding, at the monthly rate of $2 for business and $1 for residences. The Central Union is now putting in instruments free of charge until it has 175 in working order, after which the prices are to be 50 cents for residences and $2 for business.

BALTIMORE, MD.—On February 20 the property, rights and franchises of the Home Telegraph & Telephone Company, in this city, were sold at auction for $175,000 to a syndicate composed of stockholders of the company and a number of Baltimore capitalists. The purchase includes a thoroughly equipped central station with over 1200 subscribers, who have been served during the receivership of the property, which has extended over a period of two years. The property will be recorganized at once.

MEMPHIS, Tenn.—A meeting was recently held in this city by a number of persons interested in independent telephone lines and exchanges, the result of which was the formation of an association called "The Southern Telephone Association." Another meeting will be held in this city on July 5, and manufacturers of telephone and telegraph apparatus are invited to be present at that time. The officers of the Southern Telephone Association are: James D. Randall, of Memphis, president; C. W. Bolton, of Pontotoc, Miss., secretary; and George W. Scheuing, of Memphis, treasurer.

ST. LOUIS, MO.—The Kinloch Telephone Company has issued the first number of its directory, which is dated January 31, 1899. It contains 4294 names, classified alphabetically, also according to business. Every telephone is on a copper wire metallic circuit and equipped with long-distance transmitters. The company's charges are as follows: Business telephones, $60 per annum; physicians' offices, $50; physicians' offices in residences, $36; residences, $36; desk telephones, $20; extension telephones, $20; extension bells, $5 for installation—no rent. The directory contains 168 pages and is substantially bound.

THE PACIFIC CABLE.—The United States Senate Foreign Relations Committee, on February 20, reported favorably for the incorporation in the sundry civil bill an amendment authorizing a contract with an American company for transmitting Government telegrams to Hawaii, Manila and Japan for twenty years. The compensation is not to exceed $175,000 a year, and the contract will be awarded to the lowest responsible bidder, who will deposit a $400,000 bond to fulfill the conditions. At the end of the contract the rate for Government messages is to be one-third that for commercial messages, which are fixed at 25 cents per word to Hawaii and $1 to Manila, the right being reserved to revise these rates at the end of ten years. The subsidy payments are not to be paid as dividends, but are to form a special fund for the renewal and repair of cables.

Electric Light and Power.

UTICA, N. Y.—The Herkimer Light & Power Company has increased its capital stock from $400,000 to $500,000.

PATERSON, N. J.—S. Scheuer & Co., of this city, have recently added to their electric light plant an engine built by the Ball Engine Company, of Erie, Pa.

PORTLAND, ME.—The Cumberland Illuminating Company is building a power house in Deering and setting up two large transformers for the distribution to Woodfords.

CHICAGO, ILL.—A Boston store in this city has just installed an electric light plant, including a Western Electric 60-kw generator, direct-connected to a 100-hp engine built by the Ball Engine Company, of Erie, Pa.

ABERDEEN, S. DAK.—The City Council has made a proposal for the purchase of the electric light and gas plant, which has been accepted by the owners of the property. The plant is bonded for $35,000. The city will assume this debt and in addition pay the owners the sum of $3,500.

ATLANTA, GA.—After an experience of several months in operating an isolated plant for the lighting of the post office and custom house of this city, the Government has decided to shut the plant down, and has contracted with the Georgia Electric Light Company to light these buildings.

GREENVILLE, MISS.—The Greenville Light & Car Company has secured the contract to light the city of Greenville with sixty or more arc lights of 2000 candle power, for ten years, and has issued $40,000 bonds for the purpose of adding to its present electric lighting business a small system of electric street railway, the construction of which will be finished before July 1 next.

SPRINGFIELD, VT.—At the meeting of the directors of the Springfield Electric Company, held on February 18, the following officers were chosen, viz.: William F. Hazelton, president; William D. Woolson, vice-president, and Henry B. Holmes, secretary and treasurer. It was voted to start a day service beginning April. Alternating-current motors, 15,000 alternations, will be needed.

BATESVILLE, MISS.—Mr. D. L. Rush, of this place, has just completed the electric light plant installed for the Hon. L. L. Pearsons. The lights were turned on for the first time on Saturday night, February 19. Batesville has about 900 inhabitants, and an up-to-date alternating plant of 600 lights capacity, nearly 2 miles of primary circuits and eight enclosed arc lamps to light the main streets.

NEW YORK, N. Y.—The Citizens' and the Municipal Electric Light companies of Brooklyn Borough have instituted suit against the city for $500,000 for lighting the streets of Brooklyn Borough for part of the year 1897, the year 1898 and the month of January, 1899. It is stated that the bills were regularly presented each month, as the law stipulates, and were approved by the Department of Public Buildings, Lighting and Supplies, but that it is simply another case of "hold-up" by the Municipal Assembly.

SWEETWATER, TENN.—The Mayor and Board of Aldermen of Sweetwater, Tenn., have granted a twenty-year franchise and closed contract with the Sweetwater Telephone & Improvement Company for the erection of an electric light plant. The company is to furnish the city fifteen or more 2000-cp arc lights, and will also furnish 400 to 600 16-cp incandescents for commercial and private use. It is in the market for an alternating-current dynamo, boilers, engine, 75 to 100 hp; wire, fixtures, and all material, except poles, for the complete construction of the plant. The plant is to be completed by June 20, and work will commence in thirty days.

DERBY, CONN.—The Housatonic Power Company has asked the State Legislature for an amendment to its charter to enable it to construct a dam for the purpose of utilizing the water power at Zoar Bridge, 5 miles from this city. Electricity will be generated for distribution for light, power and heating purposes throughout New Haven and Fairfield counties, and power will be transmitted to all points in the Housatonic Valley from Bridgeport to New Milford; in the Naugatuck Valley, from Milford to Waterbury, and to Danbury, South Norwalk and other places in western Connecticut. The proposed dam will be 400 feet wide and 35 feet high, and it is estimated that 20,000 horse-power will be available.

ELECTRIC POWER IN IRRIGATION.—It is proposed to utilize electric power in the development and fertilizing the vast areas of arid lands in the Southwestern section of the country. In Utah, Nevada, New Mexico, Arizona and California there are great tracts that cannot be irrigated on account of the prohibitive cost of the coal necessary to generate power and the inadequate roads, over which machinery cannot be transported. It is now proposed to build a central power station whence lines will radiate in various directions to substations, which will supply power for the sinking of artesian wells and doing other work in the irrigation of the lands. It is stated that electrical machinery to do this work has already been contracted for. Coal will be stored at the central station, and electrical energy will be transmitted to the substations, whence it will be taken directly to points where it is desired to utilize it.

THE ELECTRIC RAILWAY.

HACKENSACK, N. J.—The old Union Traction Company has been reorganized under the name of the Newark & Hackensack Traction Company.

CALUMET, MICH.—A project is on foot to build an electric railway line about the copper district. It is stated that Boston capital is backing up the enterprise.

WORCESTER, MASS.—The Blackstone Valley Street Railway Company has petitioned the Selectmen of Northbridge for a franchise to extend the road to Whitinsville.

TRENTON, N. J.—The Lawrence Township Committee has granted the right of way to the Trenton Street Railway Company to construct a trolley line alongside of the Lawrenceville road from this city.

NEWARK, N. J.—The Orange & Passaic Valley Railway Company has given a mortgage for $1,000,000 to the New Jersey Title & Guarantee Company, of Jersey City, to secure the 5 per cent. bonds to be issued by the railway company.

DETROIT, MICH.—The new Detroit, Plymouth & Northville electric road is now open for business and is rendering regular service. The time of transit from the City Hall in Detroit to Plymouth is one hour and thirty minutes. The fare is 30 cents.

WASHINGTON, D. C.—To reward the employees of the Columbia Railway Company for their faithful service during the recent blizzard, the board of directors of the company voted a resolution of thanks to the men and gave them an extra day's pay.

BALTIMORE, MD.—The Council Committee on City Passenger Railways has decided to report favorably the ordinance compelling the City Passenger Railway companies to provide vestibules or other shelters on their cars for the protection of motormen.

LOGANSPORT, IND.—The Logansport Street Railway has been sold to Messrs. George J. Marrott and Charles Dwyer, of Indianapolis, for $100,000. They paid $20,000 and assumed an indebtedness of $80,000. The road has been in the hands of a receiver since July 3, 1891.

BALTIMORE, MD.—The Newport News & Old Point Electric Railway Company has authorized the preparation of plans for the building of a large power house at Hampton, Va., to replace several old power houses. The new structure will have a capacity of 2000 horse-power.

PORTLAND, ME.—The Portland Railroad Company, it is reported, has purchased the Portland & Cape Elizabeth Electric Railway. The amount involved in the transaction is not made public. It is stated to be the ultimate intention of the Portland company to increase the facilities of the Deering power house and generate there all of the power necessary for the entire system.

DOYLESTOWN, PA.—The Bucks County Railway Company, which operates a trolley road between this place and Willow Grove, has been placed in charge of the Doylestown Trust Company as receiver. It is believed that the affairs of the company can be soon straightened out. The receivership was asked for, it is stated, because of the lack of harmony among interested parties.

LEXINGTON, KY.—Consolidation has been effected in this city bringing under one management all the Belt Line associated companies, the Passenger & Belt Railway Company, the Belt Electric Line Company, the Central Electric Company, and the Hercules Ice Company. The name of the new company is the Lexington Railway Company, and its capital stock is placed at $800,000.

ALBANY, N. Y.—The Albany, Helderberg & Schoharie Electric Railway is in the market to buy railroad ties, so as to be ready to complete the road in the spring. The proposed route of the road from the city of Albany includes Normansville, Elsemere, New Salem, Indian Ladder, East and West Berne, to Schoharie. Richard Schermerhorn, of Brooklyn, N. Y., has been appointed chief engineer.

CINCINNATI, OHIO.—Application has been made for the appointment of a receiver for the Ironton Electric Light & Street Railway Company, Ironton, Ohio. The application was denied by the court on the ground that due notice of the action had not been served on all interested. Notice will be given and then another application will be made. It is stated that the road's finances are much involved.

HOBOKEN, N. J.—It is reported that the New Jersey Electric Railway, commonly known as the Jersey City, Hoboken & Rutherford Electric Railway, has been purchased by the syndicate which controls the North Jersey Street Railway Company. The New Jersey Electric Company, which has 42 miles of track, extending from the ferries in Hoboken to Singac township, went into the hands of a receiver several months ago.

THE CAIRO, EGYPT, ELECTRIC STREET RAILWAY.—In the issue of THE ELECTRICAL WORLD of December 31, 1898, was published an illustrated description of the electric street railway in Cairo, Egypt, in which it was stated that Sulzer engines were used. THE ELECTRICAL WORLD is now informed that the engines were constructed and supplied by Franko Tosi, Legnano, Italy. They are provided with Mr. Tosi's patented steam valves and gearing.

BOSTON, MASS.—It is stated that negotiations are now under way for the consolidation of various Massachusetts street railways, involving the North Shore Traction Company, the Wakefield, Gloucester, Lowell, Lawrence, Haverhill and Merrimac Valley lines and other roads in the eastern part of the State. State Treasurer Shaw, who is largely interested in the enterprise, states that a proposition has been made by a syndicate to buy the $2,000,000 North Shore Traction preferred at $85 and $4,000,000 common at $20 per share. The amount involved in the pending consolidation is about $4,000,000.

PERSONAL NOTES.

LIEUT. GEORGE O. SQUIER has been nominated by the President to be first lieutenant, Signal Corps, regular army. Lieut. Squier was news censor for the Government at New York during the war with Spain. He is co-inventor, with Prof. A. C. Crehore, of the synchronograph system of telegraphy.

MR. CHARLES J. GLIDDEN.—The Boston "Sunday Journal," of February 19, devotes over a page to a large portrait and biographical sketch of Mr. Charles J. Glidden, president of the Erie Telegraph & Telephone Company. Mr. Glidden is so well known to the electrical fraternity that a few words concerning his career may not be amiss at this time. He was born in Lowell, Mass., on August 29, 1857, and is a descendant of a family of English origin which came to this country about the year 1700, the representatives of which have been prominently associated with the development and progress of the section of the country in which they lived. The subject of this sketch attended the public schools of Lowell until he was fourteen years of age, when he secured a position as telegraph messenger boy. He has ever since been connected with electrical enterprises, running through the scale of positions from telegraph messenger to president of one of the largest telephone organizations in America. In the early days of the telephone Mr. Glidden perceived the great future value and use of the instrument, and has ever since devoted his attention to its development and introduction. To go back to his messenger days. Mr. Glidden's first service was with the Northern Telegraph Company, which afterwards became the Franklin Telegraph Company—the Franklin Telegraph Company being afterwards merged with the Atlantic & Pacific Telegraph Company, which was afterwards absorbed by the Western Union. Mr. Glidden at the age of fifteen held the position of night manager of the Springfield, Mass., office of the Franklin company. He afterwards served in Manchester, N. H., until the consolidation of the Atlantic & Pacific with the Western Union Company in 1877. At the same time he also acted as local correspondent of the Boston "Globe,"

MR. CHARLES J. GLIDDEN.

"Transcript" and the "Traveller." His telephone work dates from the year 1876, and he is, consequently, a pioneer in the business. In that year he made the acquaintance of Professor Bell, and arranged with him for a test of the telephone between Manchester and Boston over the lines of the Atlantic & Pacific Telegraph Company. The test was successful, and so has Mr. Glidden been from that time on. Mr. Glidden had so much confidence in the instrument that he invested all his capital in its development and urged others to do the same. This was the foundation of his prosperity. In 1877, after leaving the telegraph service, he constructed private telephone lines in Manchester and Lowell, and suggested to the Bell Company the advisability of establishing an exchange system. This, it is said, was the first suggestion of a central exchange. Mr. George L. Bradley, who was then treasurer of the Bell Company operating in New England under the name of the New England Telephone Company, told Mr. Glidden that if he would secure fifty subscribers in Lowell an exchange would be built. Mr. Glidden began the canvass in 1877, and believes that he secured the first subscriber to a telephone exchange in the world. He and others purchased the Lowell system from the Bell Company in 1879, and later took in the Manchester, Worcester and Fitchburg systems, also those in the State of Maine, in fact all the properties now making up the New England Telephone & Telegraph Company. He was treasurer of all the companies until the consolidation in 1883 with the New England Company, accepting the position of secretary, which position he held until the Erie system was well under way, resigning it to give his exclusive attention to the management of the Erie. Mr. Glidden organized and constructed with others under the name of the Pioneer Telephone Company the first long-distance line in the world, namely, from Lowell to Boston. The line was originally opened with two grounded circuits; now there are no less than forty wires between the two points named. Mr. Glidden at the present time is president of no less than five telephone companies and one banking company. A list of these, together with the capital employed in each, is given as follows: Cleveland Telephone Company, $2,400,000; Northwestern Telephone Exchange Company, $3,700,000; Southwestern Telegraph & Telephone Company, $5,000,000; Michigan Telephone Company (recently acquired), $3,250,000; Erie Telegraph & Telephone Company, $10,000,000; Trader's National Bank, capital, surplus and deposits, $2,650,000. Total, $27,000,000. The total length of the wires of the various telephone companies under Mr. Glidden's management, if joined end to end, would make a length of 100,000 miles, enough to four times encircle the earth at the equator. The service includes 52,000 subscribers. Mr. Glidden is an extremely active man, and as he travels a great deal he uses a private car and conducts business "on the fly," so to speak.

OBITUARY NOTE.

JOHN KRUESI, the chief mechanical engineer of the General Electric Company, died on February 22 last at his home in Schenectady. His death, which resulted from an attack of grip, occurred quite suddenly, after an illness of only three or four days. The funeral services were held on Saturday afternoon, February 25, and were very largely attended, not only by the officers, heads of departments and employees of the General Electric Company and by residents of Schenectady generally, but also by many of Mr. Kruesi's old associates in the early Edison days of Newark and Menlo Park. Among those who came long distances especially to attend the funeral were Mr. Thomas A. Edison, Mr. Charles A. Coffin, President of the General Electric Company; Mr. Samuel Insull, President of the Chicago Edison Company; Mr. Charles A. Batchelor, of New York; Mr. Sigmund Bergmann, of New York; Mr. F. P. Fish, general counsel of the General Electric Company; Mr. J. W. Lieb, Jr., general manager of the Edison Electric Illuminating Company, of New York; Mr. W. S. Barstow, of the Brooklyn Edison Company; Mr. S. Dana Greene, general sales manager of the General Electric Company; Mr. C. T. Hughes, manager of the New York office of the General Electric Company; Mr. W. E. Gilmore, of Orange, N. J.; Mr. Wilson Howell, of Harrison, N. J.; Mr. John Langton, of New York; Mr. F. R. Upton, of Orange, N. J., and Mr. Martin Insull, of Chicago. The body was taken to Vale Cemetery, Schenectady, for interment. The pall bearers were Mr. Samuel Insull, Mr. Charles Batchelor, Mr. A. J. Pitkins, vice-president of the Schenectady Locomotive Works; Mr. G. E. Emmons, general manager of the General Electric Company's works at Schenectady; Mr. E. W. Rice, Jr., third vice-president of the General Electric Company, and Mr. John D. Remor, of Schenectady.

John Kruesi was born in Spercher, Canton Appenzell, Switzerland, in 1843, and went to work in a machine shop at an early age. He found his way to Paris in 1867, the year of the Exposition, and remained there working in various mechanical industries until the outbreak of the Franco-German war in 1870. He then went to London, where he stayed for some months, and finally resolved to make his home in the United States, which he reached in December, 1870. He was employed by the Singer Sewing Machine Company at Elizabeth, N. J., for two years, and then, in June, 1872, went to work for Mr. T. A. Edison, who, with Mr. Unger, was manufacturing stock exchange tickers and telegraph instruments in Ward street, Newark, N. J. Mr. Edison in 1875 opened a second shop in Green street, Newark, for purely experimental work, and John Kruesi was one of the first men utilized in this field. During the next five or six years he was either in the Green street shop or at Menlo Park. He was practically Mr. Edison's machine foreman, not only designing and making special apparatus required by Mr. Edison to fit the conditions, but also often making the special tools necessary for newly invented apparatus. During this five years—from 1876 to 1881—Mr. Edison was busy with the phonograph, improvements on the Bell telephone, incandescent electric lighting, electric railway experiments, and, above all, the subdivision of the electric current necessary to make incandescent lighting successful as a commercial venture. Mr. Kruesi was a most tireless worker, as well as being one of the most fertile in suggestions to overcome the difficult obstacles to success which were constantly arising. The first phonograph was madde by Mr. Kruesi in Menlo Park, in 1877, from a rough sketch made by Mr. Edison. In 1881 incandescent electric lighting had passed beyond the stage of experiment, and the Electrical Tube Company was formed with Mr. Edison as president, Mr. Samuel Insull as secretary and Mr. Kruesi as treasurer and general manager to make and lay down underground electric conduits in New York city and elsewhere. The first shops of this company were in Washington Street, New York City, and there Mr. Kruesi, often with his own hands, turned out the early conduits which were laid down in the lower part of New York City—the first two wire conduits for lighting or power to be placed in service in any part of the world. Nearly all the early patents for improvements in underground conduits bear Mr. Kruesi's name as inventor.

The Electrical Tube Company, after moving its shops to Bridge Street, Brooklyn, was after a short time absorbed by the Edison Machine Works, whose shops were then in Goerck Street, New York. This was in 1883. Mr. Charles A. Batchelor was then general manager of these works, and Mr. Kruesi became his assistant. In 1886 the Edison Machine Works were removed to Schenectady,

THE LATE JOHN KRUESI.

Mr. Samuel Insull becoming the general manager, and Mr. Kruesi retaining his place as assistant general manager. Mr. Insull himself gives Mr. Kruesi credit for having designed and constructed all the shops which were erected while he was general maanger—that is, from 1886 to 1892. In 1892 Mr. Kruesi succeeded Mr. Insull as general manager, and in this capacity had charge of the Schenectady works until 1896, when he was appointed chief mechanical engineer to the company. During his long connection with Mr. Edison and the various companies which were his successors, Mr. Kruesi made many important improvements and inventions in machine tools. He was also, from his thorough understanding of the strong and weak points of apparatus, a salesman of more than average ability, when his services were wanted in this capacity. He had a large and varied electrical knowledge, particularly in his keen recollection of numerous experiments which had turned out failures, and of the reason why success along some particular line could not be achieved. Most of all he was praised by hosts of friends for the absolute honesty of every side of his character.

Mr. Kruesi was a widower, his wife having died in January, 1897. He leaves a family of eight children, the eldest of whom is now in England.

Mr. Kruesi's will, which was read after the interment, appointed Mr. Thomas A. Edison, Mr. Samuel Insull and Mr. Charles A. Batchelor as executors.

Trade and Industrial Notes.

REMOVAL.—The Otis Elevator Company on March 1 moved its offices to the Empire Building, 71 Broadway, New York.

MR. H. A. MAY, 347 West Fayette Street, Syracuse, N. Y., is sole agent for the G. L. Van Namee Manufacturing Company's arc lamp hoods for the United States and Canada.

MESSRS. D. L. BATES & BROTHER, Dayton, Ohio, have issued a neat pamphlet descriptive of their fan motors of all types. An illustrated description of one of these machines is given on another page of this issue.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has issued its 1899 catalogue and price lists of machine tools, cutters, small tools, gauges, etc. It contains 446 pages and is fully illustrated.

MESSRS. PASS & SEYMOUR have made arrangements with Joseph M. Zamoiski, 515 Equitable Building, Baltimore, to represent them in the Southern States. They report large sales and brilliant prospects.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., has just appointed Messrs. Mayer & Englund, of 10 South Tenth Street, Philadelphia, Pa., its representatives in the Middle States territory for its line of railway lightning arresters.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is now thoroughly established in its new quarters. A tour of the new building shows very conclusively the company's superior facilities for successfully handling a large electrical supply business.

THE MERCER ELECTRIC MACHINE COMPANY, of Dawson, Ga., manufacturers' agents and dealers in electrical specialties, will soon discontinue

its business. Mr. Walter A. Mercer, who has been connected with the firm as manager, will make Indianapolis, Ind., his headquarters after March 1.

MR. WM. ROCHE, manufacturer of the "New Standard" dry battery, 259 Greenwich Street, New York, will move into larger quarters so as to better handle his growing business. He states that the demand for the "Standard" dry battery continues to increase. It is widely used for all purposes where battery currents are applicable.

FIRE, on the morning of February 23, destroyed the manufacturing plant of Messrs. Roth Brothers & Co., Chicago. The firm will, however, resume business as soon as it can find a suitable location, and hopes to be able, within a few weeks, to accept orders and fill them with its usual promptness. The firm's temporary address is 236½ East Madison Street.

MESSRS. EUGENE MUNSELL & CO., New York, have leased a large building in Ottawa, Ont., where they will establish a mica factory. It is their intention to forward mica direct from the mines to Ottawa, where it will be prepared for shipment to New York. An agent, as yet unnamed, will be appointed to look after the firm's interests in Ottawa.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., has just completed the filing of a $30,000 order to the Louisville "Courier-Journal." This company has also just equipped two large Southern plants with American Ball engines, direct-coupled to generators. These plants are for the Porvenir Sugar Estate, in Santo Domingo, and the Trinidad Sugar Company, of Cienfuegos, Cuba.

SEARCH LIGHT PROJECTORS.—The Carlisle & Finch Company, Cincinnati, Ohio, has issued a neat catalogue of its search light projectors. Half tone illustrations of the various types of lamps are given, together with a diagram of the connections. The company is now making lamps for all purposes, from a 7-inch lamp for a naphtha or steam launch to the most powerful marine projector. The lamps are said to operate under the most severe conditions, and are not affected by rain, snow, ice, dust, etc.

THE MICA INSULATOR COMPANY, New York and Chicago, makes a specialty of furnishing "Micanite" commutator segments for any style or type of machine, and has recently manufactured some segments 30½ inches long and 4 inches high. Electrical engineers not familiar with the value of "Micanite" as an insulator for commutator segments and rings will do well to write to the company on the subject. The company reports a very heavy business both in this country and in Europe. The company's sheet insulation manual and data book gives the breakdown tests of insulation, and contains samples of the goods manufactured by it.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, manufacturer of the "Shelby" and "Y Ray" incandescent lamps, has opened a permanent office in New York City in the Fidelity & Casualty Building, 97-103 Cedar Street, with Mr. John F. Outwater in charge. For the past ten years Mr. Outwater has been connected with the Brooklyn Edison Company in various responsible positions, latterly as purchasing agent. The numerous friends that he made as buyer will no doubt be glad to reciprocate, when in position to do so, now that he is on the other side of the counter. Mr. Outwater states that he is in position to furnish the trade with any and all type of lamps ranging from ½ to 50 50 candle power, of 2 to 250 volts.

PATRIOTISM OF THE AMERICAN ELECTRICAL WORKS.—The American Electrical Works, Providence, R. I., in accordance with its time-honored custom of commemorating each national holiday in some tangible form, marks this year's anniversary of Washington's birth by distributing to the trade a fine engraving of the Mansion House at Mount Vernon, the home of Washington. Accompanying it, on a separate sheet, are some interesting facts concerning this historical building and its locality. The patriotism of the managers of the American Electrical Works is commendable. It is a potential force in keeping alive in the busy electrical industries the true American spirit, which is one of the underlying factors of our national industrial progress and success.

LOWE & LEVERIDGE is the title of a new copartnership formed between Mr. Ernest A. Lowe and Charles W. Leveridge to carry on a general electrical supply business at 183 Greenwich Street, New York. They will pay particular attention to the needs and demands of isolated plants. Mr. Lowe has had 17 years' experience in the electrical business, and was until recently general manager for J. Jones & Son, with which firm he was associated since the fall of 1892. Mr. Leveridge has been engaged in the electrical business for seven years, during the last three of which he was in charge of the isolated plant business of J. Jones & Son. Both gentlemen are well known in the trade and have many friends, all of whom, no doubt, will wish them much success in their new venture.

THE LYNN INCANDESCENT LAMP COMPANY, of Lynn, Mass., has established a New York branch in the Electrical Exchange Building, 136 Liberty Street. This office is in charge of Mr. Wm. N. Famous, one of the first lamp salesmen in the United States and a thoroughly practical incandescent lamp expert. The company is just issuing a very readable little treatise on the renewing of burned out lamps, in which it asks: "If the main spring of your watch is broken, do you throw the watch away? If the wick of your piano lamp is burned out, do you consign the whole lamp to the dump? Then why throw away the most valuable part of an incandescent lamp simply because the filament is consumed?" Wherever it is possible an expert will be sent from the New York office to ascertain the exact requirements as to voltage, efficiency, etc., on receipt of inquiries or orders, and in this way suitable lamps will always be supplied.

THE EUREKA ELECTRIC COMPANY, 157-159 South Canal Street, Chicago, states that it has met with gratifying success with its telephone apparatus. It is now placing on the market a strictly high-grade line of telephones, and is receiving daily some desirable contracts. The principal features of its instruments are the amplifying long-distance transmitter which, for articulation and quality of tone, is claimed to be unequaled by any in the market. The magnetos used are of the Eureka type, full nickeled and very powerful, and the receivers are the double-pole type and highly finished. They meet every requirement, and the many duplicate orders that the company is receiving for them indicates that these instruments are giving general satisfaction. The company's new No. 44 transmitter may be placed either upon the transmitter boxes or upon the magneto, and will give entire satisfaction either way. The company will cheerfully furnish any additional information regarding its magnetos, transmitters, receivers and other parts, as well as switchboards, cable boxes, cross-connecting boards and other apparatus used in the construction of high-grade telephone plants.

Business Notice.

"DAILY TELEPHONE ITEMS" is the name of a new paper, which has the unique distinction of having the smallest circulation and highest price of any paper published. It is compiled from clippings taken each day from 1200 papers read by Burrelle's Press Clipping Bureau, 32 Park Row, New York.

UNITED STATES PATENTS, ISSUED FEBRUARY 21, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,718. ELECTRICAL CONTROLLING APPARATUS; O. H. Pieper and A. F. Pieper, of Rochester, N. Y. App. filed January 17, 1899. In an electric-motor-controlling apparatus, the combination with the main containing case of a vertical spindle, a fixed switch-bar on said spindle, a series of contacts surrounding the spindle, contact-segments whereby brush short-circuits the armature-terminals when approaching the central position.

11,719. TELEPHONE; J. T. Gent, A. W. Staveley and I. H. Parsons, of Leicester, Eng. App. filed October 26, 1897. In a telephone, the combination with the diaphragm of a variable-resistance device consisting of suitable conducting material in a granulated or comminuted state, a pivotally or axially mounted containing or holding receptable for said material, a movable telephone-support and intermediate connections between said support and the containing or holding receptacle whereby the latter is rotated when the telephone is removed from or replaced upon the support.

619,733. ELECTRIC METER; T. Duncan, of Fort Wayne, Indiana. App. filed May 16, 1898. In an electric meter, the combination of a series energizing-coil, a U-shaped iron core, a secondary energizing-coil the shunted energizing-coil, a shunted energizing coil, and a revoluble disk armature.

619,734. ELECTRIC METER; T. Duncan, of Fort Wayne, Indiana. App. filed June 2, 1898. In a liquid-retarding device for electric meters a revoluble winged fan, an oil opposing the revolutions of said winged fan and consisting of paraffin oil and kerosene oil in the proportions herein set forth, and a detachable receiver which encloses both the said winged fan and said oleous mixture.

619,735. MULTIPLE-RATE ELECTRIC METER; T. Duncan, of Fort Wayne, Ind. App. filed June 11, 1898. In a multiple-rate system of metering the combination with the armature of a motor-meter, of a spindle carrying or supporting the said armature, a right-handed worm, a left-handed worm, and a registering mechanism operated by the said worms.

619,760. ELECTRICAL APPARATUS; T. B. Kinraide, of Boston, Mass. App. filed May 5, 1898. In an electrical apparatus, a thin, flat secondary winding wound in two similar bodies side by side proceeding from the intermediate portions of the winding constituting the secondary and each of said bodies winding in successive layers or coils progressively shorter throughout its length from the periphery to the central portion thereof, and a primary winding restricted to the peripheral portion of said secondary, part thereof being on one side and part on the opposite side of said secondary, substantially as described.

619,761. DYNAMO-ELECTRIC MACHINE; T. B. Kinraide, of Boston, Mass. App. filed September 29, 1898. In an electrical apparatus, an electromagnet for producing a magnetic field, and means for polarizing or converging the lines of magnetic force of said magnet from a large area thereof to a smaller area or pole, said means including a winding spread out coextensively with said large area and immediately adjacent to the surface of said magnet.

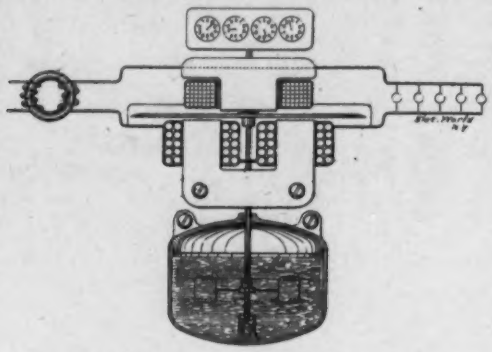
619,771. SECONDARY ELECTRIC CLOCK; J. O. Lyman, of Waterbury, Conn. App. filed August 10, 1898. An electric clock-movement comprising a plate provided with means for attachment to the co-operating parts of the movement, a pair of magnets, a forked lever having attached to one end an armature and having one branch of its other forked end bent in the form of a V, the other branch of it being bent at right angles near its extremity, and provided with a set screw, a detent having one end thereof formed to engage the teeth of a main wheel, its outer and opposite end being so formed as to engage the end of a lever, a pawl pivoted to a lever and having one end formed to engage the teeth of said main wheel, the other end thereof being formed to engage a pin, a main wheel provided with means of attachment to a lever and a plate, substantially as described.

619,783. CONDUIT FOR RAILROADS; F. S. Pearson, of Boston, Mass. App. filed February 11, 1898. In a conduit for railroads, in combination a trap in the top of the conduit, mechanism by which the trap is opened and closed and an actuator arranged to be moved by the plow or grip depend-

ing from the car whereby the trap mechanism is operated, substantially as described.

619,829. PROTECTIVE DEVICE FOR INCANDESCENT ELECTRIC LAMPS; R. Kaes, of Vienna, Austria-Hungary. App. filed August 11, 1898. In combination with a protective cover for an electric lamp, a supporting device for said cover adapted to be depressed by the fructure or depression of said cover, and a circuit making and breaking device operated by a part or attachment of said supporting device, whereby the depression of said supporting device will break the circuit.

619,885. VOLTAIC BATTERY; H. De C. Hamilton, of New York, N. Y. App. filed March 17, 1896. In a voltaic battery, a hanger of insulating



No. 619,734.—Electric Meter.

material comprising a bridge adapted to rest on the top or a cell or jar, an elongated or oblong extension underneath said bridge, and having substantially parallel vertical sides against which anode-plates may be secured, an elongated flange below said extension, said flange being thinner than said extension and being located centrally longitudinally with respect thereto and adapted to form an abutment for the depolarizer carrier or plate, and two vertically-disposed perforations in said hanger for receiving a binder or fastener for the depolarizer whereby short-circuiting through collecting escaped depolarizing material will be avoided, substantially as described.

619,890. RAILWAY SIGNAL SYSTEM; T. B. Keeler, of Rahway, N. J. App. filed July 21, 1898. In combination a track-circuit, electromagnets of different resistances and a source of electric energy common to said electromagnets, included in said track circuit, independent signal-circuits, signal-operating means and a source of electrical energy, included in each of said signal-circuits, the armatures of the said electromagnets of different resistances, each forming a part of one of the said signal-circuits.

619,896. INSULATING-CASTER; H. S. Lee, of Tecumseh, Michigan. App. filed December 27, 1898. The combination with a caster having a glass or other electrically non-conducting caster wheel, of an approximately U-shaped bail pivoted to the caster embracing the caster-wheel and adapted to be engaged with the floor.

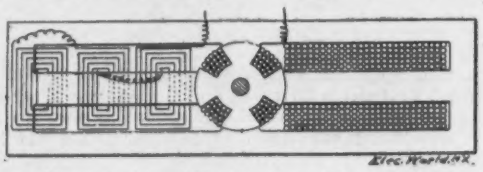
619,900. ELECTRIC SWITCH; A. H. Miller, of Central City, Colorado. App. filed December 9, 1897. A switch for controlling two electric circuits, comprising contact-points, two switch-arms, and a link having pivotal connection with one arm and sliding connection with the other arm.

619,915. TIE-WIRE OR CLASP FOR INSULATORS; F. W. Wentworth, of Paterson, N. J. App. filed December 12, 1898. A securing device for a line of wiring consisting of a bent wire having hooked ends and a bend intermediate said ends, said wire being adapted to extend around one side of a support for, and engage with its hooked ends said line of wiring, substantially as described.

619,927. ELECTRIC-RAILWAY TROLLEY; E. M. Bentley, of New York, N. Y. App. filed May 16, 1896. The combination with a pivoted trolley-arm and a spring pressing the outer end of said arm upward, of a transverse guide on which the said arm may travel and a similar transverse guide for the outer end of said spring.

619,936. ELECTRIC-CIRCUIT CLOSER; J. J. Busenbenz, of Chicago, Ill. App. filed January 11, 1898. In a circuit-closer, the combination of a chamber, formed of sections one inverted in the other, and sealed against the access of air, a mercury-contact confined in said chamber, and a contact movably supported to dip into the mercury, substantially as decribed.

619,942. ANNUNCIATOR FOR TELEPHONE EXCHANGES; W. R. Cole, of Detroit, Mich. App. filed August 25, 1897. In an annunciator, the combination of a movable signal-wing, two axially-aligned electromagnets in rear of said wing, an armature between the wing and the first electromagnet for



No. 619,760.—Electrical Apparatus.

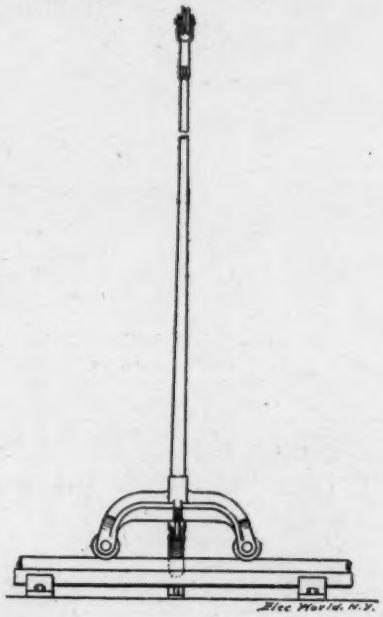
holding the wing in its normal retracted position, and armature for the second magnet in rear thereof, and means operated by said last-mentioned armature for returning the wing to its normal position.

619,974. RAIL-INSULATOR; C. B. Martin, of New York, N. Y. App. filed November 8, 1898. In combination with a rail, an insulator therefor, comprising an insulating body, a bell-shaped cap surrounding the same loosely and freely supported thereon, said cap being provided with lugs loosely engaging the rail.

620,002. SWITCHBOARD-CONNECTING CORD-CIRCUIT; G. K. Thompson, of Malden, Mass. App. filed July 16, 1898. A cord-circuit for linking together substation-circuits of diverse character divided by a repeating coil into two independent plug circuits, each plug having three contact surfaces, the tip and sleeve being in circuit with each other and normally including in series two helices of said coil, a condenser and a disconnecting signal, and the test contact surface being in circuit with a relay and battery; whereby when the plugs are inserted into substation circuits of the same or of dissimilar type each plug circuit is adapted to repeat into the other.

620,004. TELEPHONE SWITCHBOARD CIRCUIT; T. C. Wales, Jr., of Newton, Mass. App. filed October 31, 1898. In combination with substation main telephone circuits a special cord circuit, provided with one plug only, normally resting in a grounding plug-seat switch, the line-conductor terminals of said plug being in series with each other and with a retardation coil, a battery and a relay, and the test conductor terminal of the plug being in series with a second relay and a battery, the said battery having two normally open independent branches to the plug-seat switch, each having in series a supervisory signal and a resistance coil, the respective armatures of the said relays being each adapted to short-circuit one of the said signals.

620,009. ELECTRIC RAILWAY; W. R. Woodward, of New York, N. Y., and F. S. Woodward, of Graniteville, Mo. App. filed March 29, 1898. In an electric railway system the combination with a main conductor and a series of stationary insulated third-rail sections, of switches controlling the connection between such sections and the main conductor, mechanical operating devices located beyond each end of each section and reversely connected to such switches, and an electrically-propelled vehicle having means for taking current from said third-rail sections and provided with means such as a shoe for engaging with the aforesaid switch-operating devices, to close the switch before the vehicle passes onto said section from either direction, and to open said section after the vehicle passes off of said section in either direction.



No. 619,927.—Electric Railway Trolley.

620,027. INDUCTION COIL; M. E. Fuld, of Baltimore, Md. App. filed December 7, 1898. An induction coil having insulated iron wrapped upon the bobbin tube and the primary and secondary coils wound upon the said insulated iron, substantiallly as described.

620,031. CONSTRUCTING AND BONDING RAILS OF ELECTRIC RAILWAYS; S. H. Harrington, of New York, N. Y. App. filed June 17, 1897. A rail for electric railways having a beading of the same metal as the rail extending laterally from and incorporated with its web as specified, so as to afford an enlarged surface area for a bond-receiving perforation.

620,042. TELEPHONE CALL REGISTER; B. Krausse, of Wilmersdorf, Germany. App. filed August 1, 1898. In a telephone system, a registering device, a device for normally locking the same, an electrically operated releasing mechanism for said locking device, current switching devices, in connection with said releasing mechanism and with generators such as batteries, said devices being controlled by the establishment and interruption of the speaking circuit, to operate the releasing mechanism of the calling subscriber when the speaking circuit is completed, a resistance interposed between the call bell and the ground to oppose the passage of a continuous current while allowing the alternating call current to pass, and mechanism for operating the locking mechanism at the end of a conversation.

620,086. ELECTRIC HEATER; L. Casper, of Chicago, Ill. App. filed November 15, 1897. In an electric heating device, the combination of a fluid-chamber, a heating-chamber, arranged within the fluid-chamber to provide a surrounding space, insulated supports in the heating chamber, a series of resistance rods mounted in the supports, coupling conductors connecting the rods at opposite end portions in convoluted series, a removable cover closing the outer end of the heating chamber, electric circuit posts on said cover, and fingers on the first and last rods in contact with said posts, substantially as described.